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ON THE BEHAVIOR OF THE MOUNTAIN GOAT  
(*Oreamnos americanus*) IN KOOTENAY  
NATIONAL PARK

by



Elmer A. DeBock

A THESIS

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in Kootenay National Park" submitted by Elmer A. DeBock in partial  
fulfilment of the requirements for the degree of Master of Science.

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## ABSTRACT

The behavior of the mountain goat was studied during 17 months observation in Kootenay National Park. Five aspects of goat behavior were studied; comfort and maintenance behavior, social structure and behavior, play behavior, reproductive and maternal behavior. Particular emphasis was placed on reproductive and maternal behavior.

Comfort behavior was roughly divisible into seasonal and non-seasonal constant forms. Seasonal comfort behavior generally consisted of scratching, dirt-bathing and bush horning. Constant comfort behavior forms were stretching, shaking, licking, bedding and eliminative behavior. Scratching was the predominant comfort act, making up 44 per cent of all comfort acts. Dirt-bathing was the most species-typical comfort act of mountain goats. The probable stimuli of several comfort acts was discussed.

The goat population was subdivided into two sub-populations, adult males and a female-young group. The male group remained autonomous except during the rutting season when they mingled with the female-young groups. Within the population there was a linear dominance hierarchy based on age; adult males and adult females were of equal rank. Adult females dominated 2-year-olds which dominated yearlings which dominated kids. Several threat types and submissive acts are described.

Play behavior in the mountain goat begins soon after



birth and continues at a reduced rate throughout the goat's life. Two main play forms, solitary and associative, are described. Play patterns observed in mountain goat kids generally appeared to have counter parts in serious behavior.

The rutting season extends throughout the month of November with the peak occurring in the latter half of the month. The male courtship repertoire is described and discussed.

Tending bonds are formed during the second week of rut. Tending pairs try to move into semi-isolation where copulation takes place. Copulation occurred only between members of tending pairs. Formation and significance of tending bonds and tending pairs is discussed.

Male aggressive behavior and marking is described and discussed. Most fighting in males occurs during the rut, generally between evenly matched males. Four wounded males were observed in 1967, but none were observed in 1968.

Kids were born in late May and early June. Birth occurred in isolation where mother and young remained for several days before joining female-young groups. Probably the period of isolation is important for formation of a bond between mother and young. The significance of the period of isolation was discussed. The initiation and dynamics of nursing behavior are described and discussed.

Kids remained with the female for one year, until birth of the next kid when the yearling was forcefully rejected.



The significance of the mother-young distance over a year is discussed.



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## INTRODUCTION

Although the ecology of many ungulate species has been studied many remain largely unknown ethologically. The mountain goat (*Oreamnos americanus*) is one of the least known ecologically or ethologically of all North American ungulates. The mountain goat is one of two endemic ungulate species on this continent. To date Brandborg (1955), Geist (1965), Holroyd (1967) and Anderson (1940) have reported on goat behavior but only Geist (1965) gave a detailed account of one phase of behavior (rutting).

The behavior of most of the North American ungulates has been studied within the last three decades. McHugh (1958), Fuller (1960) and Egerton (1962) all studied the behavior of the North American bison (*Bison bison*). Altman (1956, 1960) and Geist (1963) have examined the behavior of the moose (*Alces alces*). Altman (1960) and Struhsaker (1967) studied the rutting behavior of the wapiti (*Cervus canadensis nelsoni*) and Davis (1938), Geist (1966) and Simons (1962, 1964) all examined certain aspects of the behavior of wild sheep (*Ovis canadensis*) and (*O. dalli*).

This study was initiated with two goals in view first, to fill some of the many gaps in our knowledge of the behavior of a unique ungulate species, and second, to provide a basis for comparisons with other studies of the mountain goat or other ungulate species.



The primary purpose of this study was a description and analysis of social behavior with emphasis on reproductive and maternal aspects. It was hoped that information gained through this study would provide a background for understanding and maintaining a rapidly unique species. Complete investigation of social structure and behavior was not practical due to the size of the population and paucity of known animals.

This study of the mountain goat in Kootenay National Park, British Columbia was initiated on May 18, 1967 and concluded on November 30, 1968. Two complete kidding seasons, two summers, two reproductive seasons and one winter were spent observing.



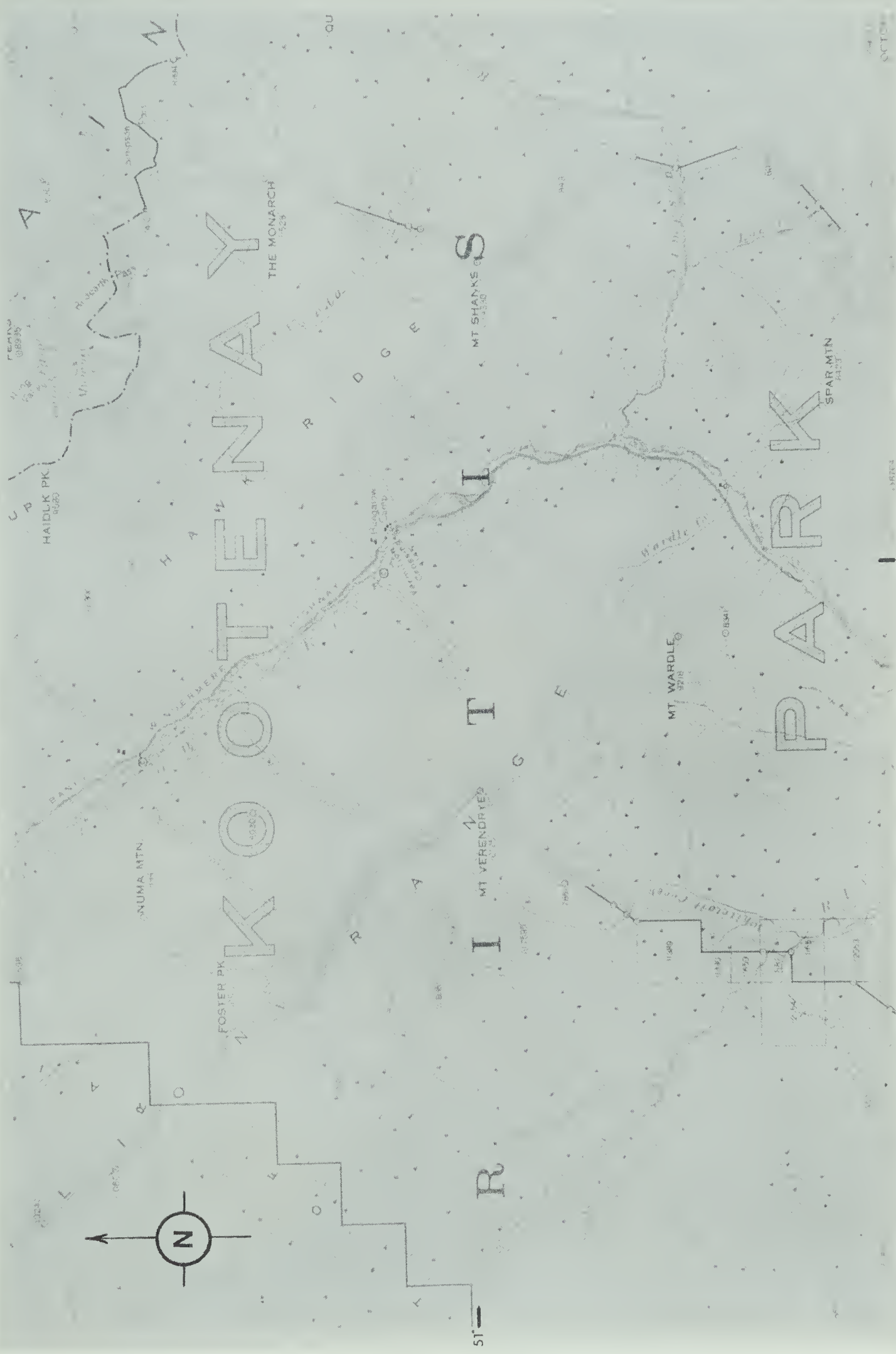
## DESCRIPTION OF STUDY AREA

The study area was centered on Mount Wardle at the southern end of the Vermilion Range, Kootenay National Park, British Columbia (Fig. 1). The Vermilion Range is the second mountain range west of the Continental Divide. Mount Wardle is situated approximately 6 miles from the junction of the Kootenay and Vermilion rivers and 30 miles northeast of Radium Hot Springs, British Columbia. The Vermilion Range runs in a nearly north-south direction dividing the watersheds of the Kootenay and Vermilion rivers (Fig. 1). The Mitchell Range lies immediately south of Mount Wardle across the narrow Vermilion valley. On the Mount Wardle portion of the study area, elevations range from 3,958 feet to the summit of the mountain at 9,218 feet (Fig. 2).

The goat population of the area changed its range seasonally. South slopes of Mount Wardle were occupied throughout late fall, winter and spring. The Vermilion Range north of Mount Wardle was occupied during summer and early fall. I refer to these regions as summering and wintering areas.

The summering areas consist of open basins and alpine slopes from about 7,000 feet to the range crest; these areas occurred on both sides of the range and on north slopes. Summering areas seemed to differ from wintering areas in having large snow covered areas for a much longer time.

Fig. 1 Map of region of study area in Kootenay National  
Park, British Columbia. Scale on map:  
1 inch = 2 miles.



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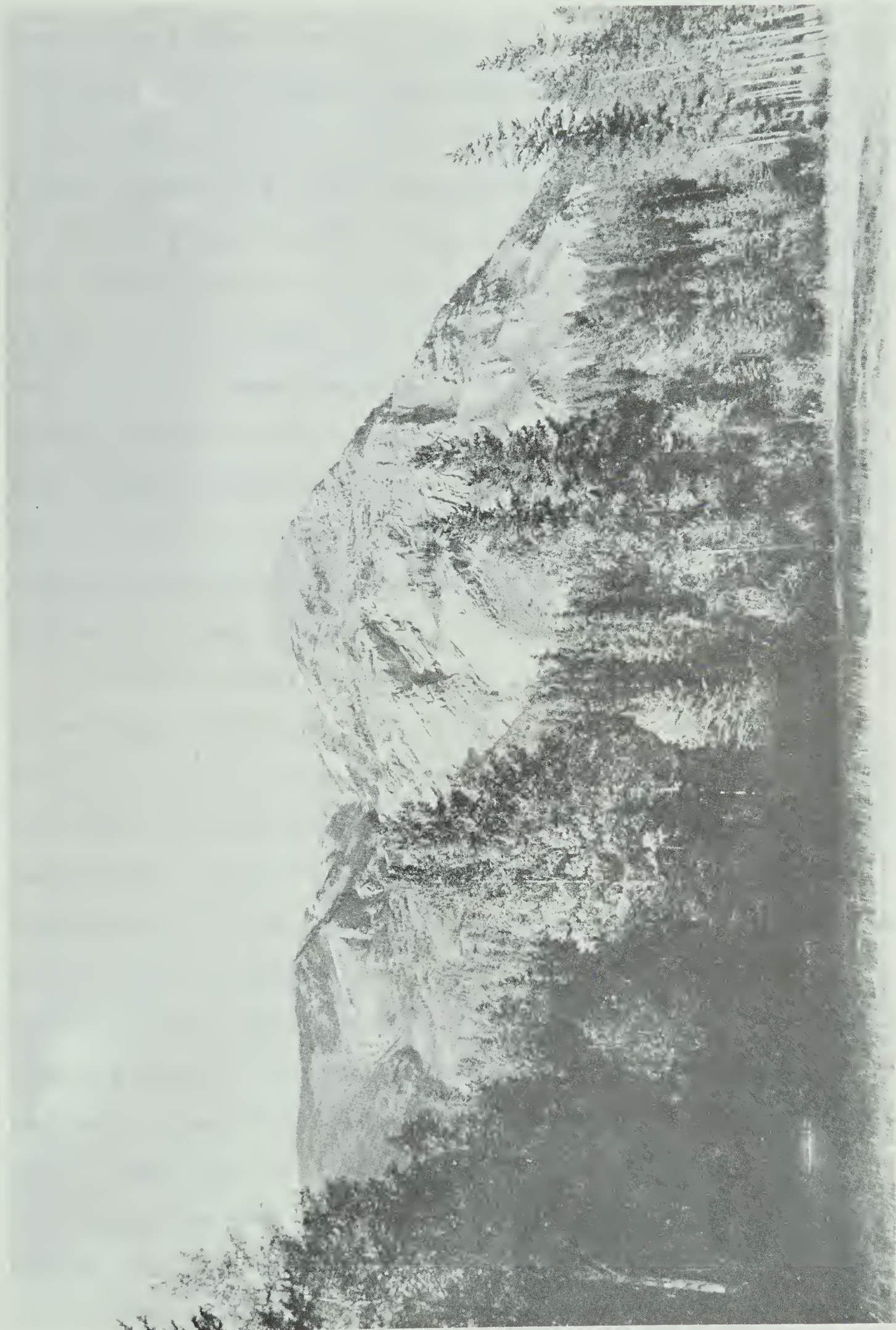
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Fig. 2 Mount Wardle study area from the southwest.





Vegetation of the summering area appeared to be characteristic of wetter climatological conditions, particularly on the north slopes of Mount Wardle. Major vegetational differences between summer and winter areas were in the types of trees, shrubs and ground cover. Large alpine larch (*Larix lyallii*) were found in extensive stands on the north slopes of Mount Wardle. Larch grades into stands of alpine fir (*Abies lasiocarpa*) in some instances. Deciduous trees are sparse north of Mount Wardle. On the lower slopes some lodgepole pine (*Pinus contorta*) occurs. Shrubs present are willow (*Salix* spp.), red osier dogwood (*Cornus stolonifera*), devil's club (*Oplopanax horridum*). Alder (*Alnus* sp.) occurred along the courses of runoff channels.

Wintering areas on the south slopes of Mount Wardle extend from 4,000 feet to 8,500 feet and for about 2.5 miles. The entire area is visible from the Banff-Windermere highway. The south and southeastern parts of Mount Wardle are extremely rugged (Fig. 3) with a series of cliffs occurring between 6,500 feet to 8,500 feet. Slopes below 6,500 feet consist of broken timbered ledges and bluffs. The western and southwestern slopes, though rough, have large amounts of open talus interspersed with snow slide paths and rock bluffs. The southern slope of Mount Wardle is gashed by five major slide-ways. There are no permanent springs or streams on the wintering area other than at the base of the slope (3,958 feet) and one small spring on the southwestern slope at 6,500 feet.

The Mount Wardle region was severely burned over in the

Fig. 3 The south and southeastern slopes of Mount  
Wardle.





1920's to an elevation of approximately 7,000 feet. Much of the vegetation is that which is commonly associated with fire succession and dry situations. The base of the southern slope is skirted by douglas fir (*Pseudotsuga menziesii*) to about 4,100 feet where this species intergrades with lodgepole pine. There are occasional stands of douglas fir up to 6,500 feet on the south slopes. Lodgepole pine extends up the eastern and western slopes to 6,000 feet. On the more southerly exposures lodgepole pine may extend to only 4,500 feet. Above the lodgepole pine on the southern slopes there are scattered open stands of aspen (*Populus tremuloides*), with a few scattered birch (*Betula* sp.), willow and maple (*Acer* sp.) in the wetter areas. Red osier dogwood occurs at the lower ends of slides along with willow, dense stands of aspen, the occasional birch and mountain ash (*Sorbus sitchensis*). On open talus slopes and around the edges of aspen or lodgepole pine stands, several shrubs occur: juniper (*Juniperus scopulorum* and *J. horizontalis*), wild rose (*Rosa* sp.), saskatoon (*Amelanchier alnifolia*), gooseberry (*Ribes oxycanthoides*), shrubby cinquefoil (*Potentilla fruticosa*), and golden currents (*Ribes aureum*). On the more open parts of the west and southwest slopes much of the ground cover consists of kinnikinnik (*Arctostaphylos uva-ursi*), and higher, around 6,000 feet, dwarf blueberry (*Vaccinium* sp.) and several grasses occur. Grasses were sparse except in a few places. Above 7,000 feet a more alpine type of vegetation occurred, such as



alpine fir, whitebark pine (*Pinus albicaulus*) and scattered alpine larch. At these elevations ground cover differs from that found lower on the mountain. Snow bank communities with abundant avalanche lillies (*Erythronium grandiflorum*) occur around stagnant snow slides and snow cornices. Ridge crests support a limited cover of dwarf buttercups (*Ranunculus eschscholtzii*), moss champions (*Silene acaulis*), purple saxifrage (*Saxifraga oppositifolia*), white and yellow mountain avens (*Dryas drummondi* and *D. hookeriana*) and sparse grasses. Some sedges and wild onion (*Allium cernuum* and *A. schonoprasum*) occur in damp places with yellow heather (*Phyllodoce empetriformis*), red heather (*P. glanduliflora*) and dwarf willows. Below snow cornices and along many runoff channels thick growths of white flowered rhododendrons (*Rhododendron albiflorum*) occur.

There are five mineral licks on the wintering area, four of which are semi-natural. The one natural lick is a small mud seep on the southwestern slope of Mount Wardle. Two mineral licks are located on cutbanks above the highway and were probably created when the highway was built, a third is situated in a limestone quarry near the highway. The attractiveness of the quarry mineral lick is enhanced by the presence of one of two cold springs on the winter area. The fourth mineral lick was deliberately created by park wardens placing blocks of stock salt on the slope above the Banff-Windermere highway.

Seasons in the study area differed from those in lower



areas, mainly in that the onset of most seasons was more abrupt and some of the seasons more prolonged. Factors important in accelerating or retarding particular seasons were temperatures, snowfall and winds, to varying extents. Snowfalls may occur during any season but permanent snow tends to appear first in late October to mid-November. Table 1 briefly outlines the chief recognizable features of the seasonal classification used.



Table 1 Description of seasons

	Early spring	Late spring	Early summer	Late summer	Early fall	Late fall	Winter
Calendar interval	Early April to mid May	Late May to early June	Late June to mid July	Late July to end of August	Early September to mid October	Mid October to mid November	Mid November to early April
Temperatures	Freezing at night cool during day	Cool at night mild during day	Mild at night warm during day	Often freezing at night warm during day	Freezing at night mild during day	Freezing days and nights	Cold
Snow cover	Melting and freezing nightly	Snow line retreating above 7,000 feet	Few snow cornices remaining	Periodic light snowfalls on mountain crests	Regular but temporary snowfalls	Permanent snowfalls	Heavy snow cover



## METHODS

Residence for the first summer was a mountain tent, thereafter a house trailer. Fly camps (tarpaulin and sleeping bag) were used during the summer when I followed the goats back to the summering areas. All transportation in the field was on foot because of extreme ruggedness of the study area.

Observations of behavior were made with the aid of 10x40 Leitz Trinovoid binoculars and a Bushnell spotting telescope with 20x, 25x and 60x eyepieces. To reduce the possibility of disturbing the goats observations were made from 100 yards or more (1500 yards), except when the goats were at mineral licks. Goats were generally aware of my presence but appeared undisturbed if no abrupt or secretive movements were made.

Acts were timed with a stop watch and a wrist watch. A Pentax SVI 35 mm still camera with wide angle and 200 mm telephoto lenses and a Konica Super 8 6TL 8mm movie camera were used to record behavior.

The altitude of several obvious reference points on the mountain was determined with a Terra T5 altimeter. These points were used as reference points in estimating the altitude of goats. The position of each point was marked with mining tape.

At least 5 days per week were spent in observation of goat behavior. Time budget data were collected by observing



with a spotting scope one to three animals for a period of 8 hours. The occurrence of each act, and its nature and length, were recorded on prepared data sheets.

In an animal with such a slight degree of sexual dimorphism as the mountain goat, differentiating the sexes is always difficult. Difficulty of identification of the sexes varies with the season. When a kid or yearling is at heel there is little doubt but when an adult goat is alone careful examination is necessary before identification is certain. In several instances in the Mount Wardle population variation from the norm made identification of the sexes more difficult.

The most consistent and useful method of differentiating sex is horn shape and size. The male horn has a smooth curve from base to point, whereas the last segment of the horn in the female characteristically has a sharp hook. Male horns diverge slightly whereas female horns sometimes diverge widely (although the horns of some females diverge no more than those of males). Male horns are relatively greater in diameter than that of the female throughout their length (Figs. 4 and 5).

In the reproductive season males and females are readily differentiated since males are often heavily soiled on the flanks and abdomen from pit digging. Males are identifiable on the basis of several acts and postures such as horning bushes (during the rutting season), urination postures and attitude towards females (sexual examination).

Fig. 4 Generalized conformation of male horns

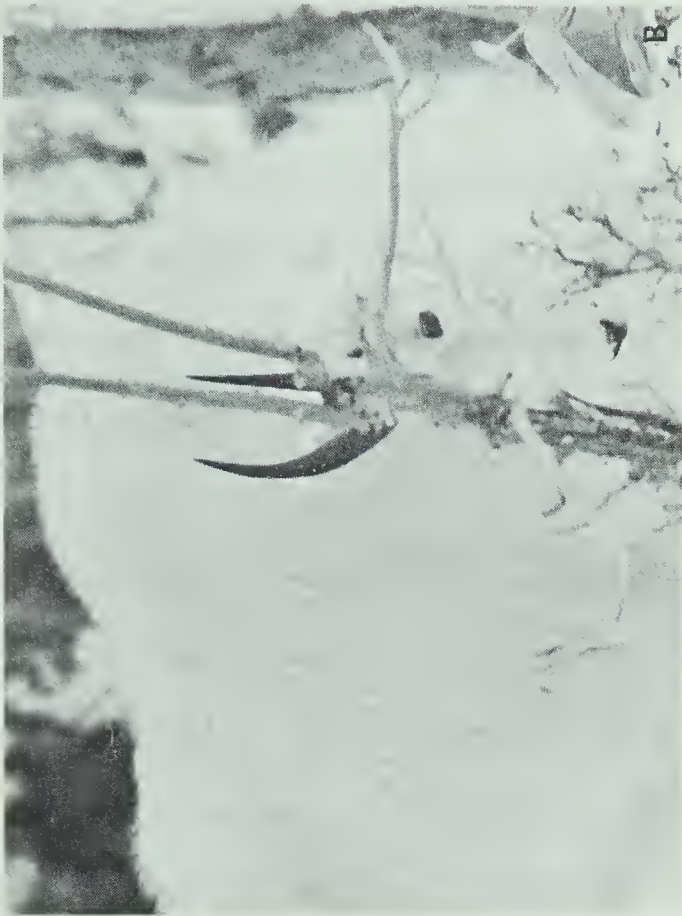
A. Profile view

B. Frontal view

Fig. 5 Generalized conformation of female horns

C. Profile view

D. Frontal view





An adult male when close to an adult female may also be differentiated by body size, the male being much larger.

Kids, yearlings and 2-year-olds could be readily differentiated on the basis of body size, horn growth and conformation of face (Fig. 6). Beyond the age of approximately 2.5 years, size differentiation becomes uncertain. In this thesis young goats are considered to be kids until their first birthday, yearlings until their second, and 2-year-olds until their third birthday.

Since none of the goats on the study area were marked artificially, (by agreement with the National Parks) recognition of individuals was difficult. Lack of individual variation within a group of goats increased the problem of identification as did the large numbers of animals in the population (approximately 150).

Temporary identification (1 day) of some goats was established by small individual characteristics and during the summer, by molt patterns. Temporary identification of individual males could be made during the reproductive season by degree and pattern of soiling of flanks from digging rutting pits. These methods of identification were feasible only in small groups of goats.

Permanent or semi-permanent identification was possible for thirteen animals which were identifiable by means of deformities or damaged horns. The presence of what appeared to be twin kids identified one female in the wintering population.

Fig. 6 Body sizes of kid, yearlings and two-year-olds as compared to an adult female.

- A) Female and 10-day-old kid (Picture taken in June).
- B) Female and 4-month-old kid (Picture taken in September).
- C) Female and yearling (Picture taken in June).
- D) Two-year-old female (24-month-old) (Picture taken in June).
- E) Two-year-old female (30-months-old) (Picture taken in December).
- F) Adult males in July.
- G) Adult male in December.







F



E



G



To derive some measure of the strength of the maternal bond, a series of distance classes were devised using an arbitrary scale. Four classes were used based on an estimation of the distance a kid was from its dam. Length of the dam was used as reference length. The four classes were as follows:

C1 = 0 - 3 yards  
 C2 = 3 - 20 yards  
 C3 = 20 - 60 yards  
 C4 = 60 - + yards

Kids which were judged to be at the boundary of two distance classes were placed in the lower class. I attempted to estimate the frequency with which kids moved into each class throughout the year.

Observations of goat behavior were normally carried out from light till dark. Hours of observation shown in this work represent observations made from light until dusk. Length of observations varied with the seasons and day length. Observational procedure was altered from 1967 to 1968. In 1967 observations were made on an entire group of goats whereas in 1968 observations were made on one to three animals for 8 hour periods. After completion of an 8 hour observation period general group observations were carried out. The more intense 8 hour observations in 1968 tended to give somewhat larger sample sizes than a like period of general group observation in 1967.

In this work wherever the mean of a sample is given the sample size and standard deviation are included.

\*17A follows



In the following work a group or band or goats is defined as a number of goats, feeding, bedding or moving together with not more than 50 yards between individuals.



## 1. COMFORT AND MAINTENANCE BEHAVIOR

In the overall behavior of an animal there are certain acts which are directed towards the comfort of the individual animals and are termed "comfort and maintenance behavior".

### 1.1 Description of Comfort Acts

#### Eliminative Behavior

One of the most basic of comfort or maintenance behavior types is eliminative behavior. The defecation act is similar in both sexes of mountain goats, there is no special stance assumed. Defecation may occur whether the animal is moving, standing or bedded. In the urination act of the goats there is a definite sexual dimorphism. The female uses a squatting posture in which the forelegs are held rigid and close together, the hind feet are shifted forward and laterally from the body, the back is arched and the perianal region is lowered parallel to the ground (Fig. 7). In the male urination posture the hind legs are moved slightly back from their normal vertical position under the body and spread slightly. The male stands during the act (Fig. 8). No special post eliminative behavior was apparent.

#### Stretching

Stretching movements make up a large proportion of the total repertoire of comfort movements. Stretching movements are made from several positions but mostly occur in some relation to lying down.

Upon bedding goats often yawn, opening the mouth wide

Fig. 7 Female urination posture in the moutain goat.

Fig. 8 Male urination posture as shown by a male kid.





and fully extending the neck, the ears are folded back against the head (Fig. 9). With the head and neck held out straight the bedded goat may then stretch its forelegs by extending them forward and then to the side (Fig. 9).

Upon rising from their beds goats frequently perform any one of three stretching acts. In one the legs are fully extended, the animal bows its head deeply between its forelegs (Fig. 10), arches its back and draws its abdomen up. The second act seen was a flexing of the hind legs and a depressing of the pelvic region. The hind legs are extended posteriad, the hips are depressed toward the ground so that the goat leans forward placing much of its weight on its forelegs (Fig. 11). In the third type of stretch the goat stretches each hind leg separately, extending it backwards and to the side (Fig. 12).

### Scratching Acts

Scratching with the hind foot is a common type of behavior in a variety of circumstances, whether the goat is bedded or standing. In this act either hind foot may be used. While bedded the regions most often scratched are the face, neck, back of the head and behind the ears. Face and neck scratching require the animal to turn its head back along its side. The free rear foot is brought forward and makes several short quick strokes. When the back of the head or ears are scratched, the head is tilted muzzle up and pulled as far posteriorly as possible (Fig. 13).

Ribs, neck, shoulders, face, back of ears and lower

Fig. 9 Bedded female mountain goat stretching her forelegs and yawning.

Fig. 10 Stretching act in which the neck is bowed and the back is arched.

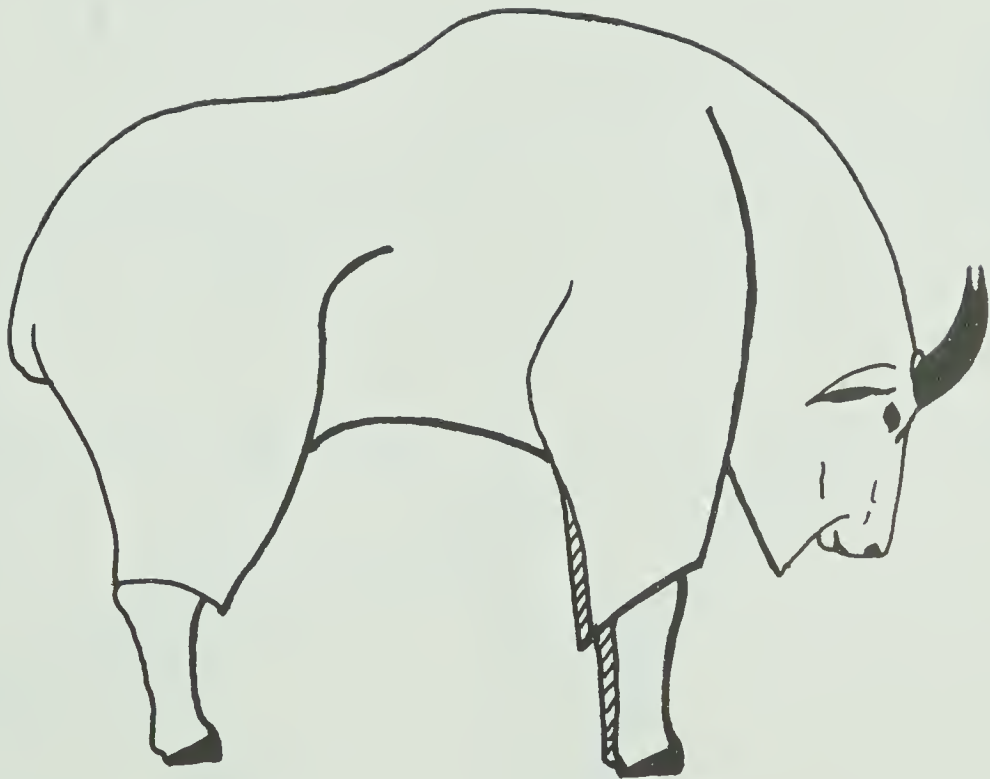


Fig. 11 Stretching act in which the pelvic region is depressed and the weight is placed on the forelegs.

Fig. 12 Stretching act in which the individual hind legs are stretched.

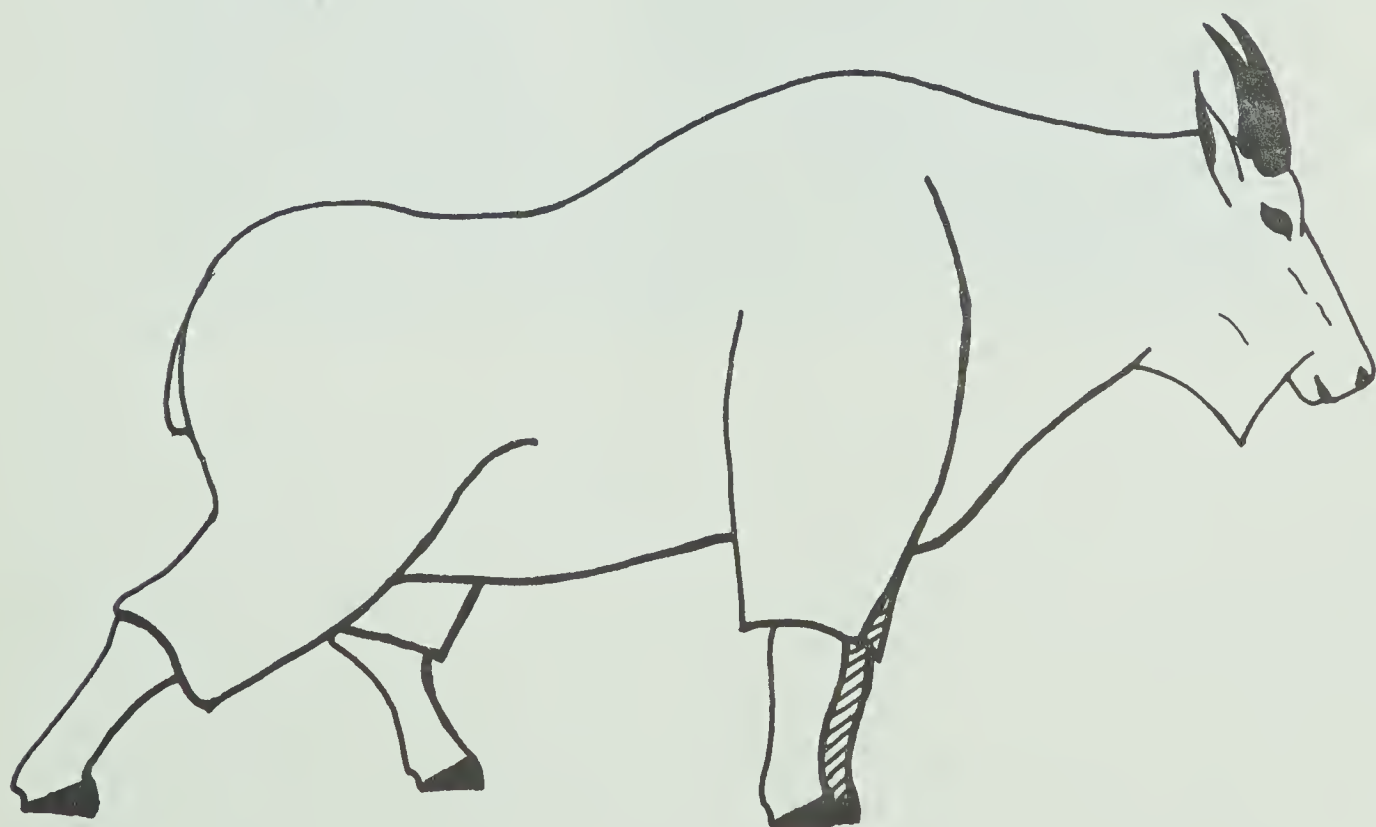


Fig. 13 Goat scratching the back of the head while  
bedded.





jaw are frequently scratched while standing. The goat twists itself to the side to be scratched and brings a hind foot laterally and forward then gives several quick strokes (Fig. 14).

A second common method of scratching employs the horns. When scratching with the horns the head is raised and bent backwards until the muzzle is raised to a near vertical position and the horn tips contact the point to be scratched (Fig. 15). The animal scratches with small circular motions of the head; with slight variation the region of the rib cage can be scratched. Goats use an anterior-posterior motion of the horns when scratching the back or ribs. I saw only bedded goats scratching with the horns.

A bedded goat may scratch the side of its head and neck by rubbing them on the ground. To scratch its head and neck the animal lies flat on its side (Fig. 16). Goats may also scratch their chin and throat on the ground. When scratching the chin and throat goats kneel on their knees, the head and neck are extended with their dorso-ventral plane at right angles to the ground surface (Fig. 17).

There are several comfort acts, observed solely during the summer, which in one form or another resemble scratching. These involve rubbing on bushes, earth banks and hummocks. When horning bushes goats stand directly in front of them, lower the head and tilt the horns forward (Fig. 18). The horns are then swept upward through the bush. The head is

A. Fig. 14 Female mountain goat scratching the side of her neck while standing.

B. Fig. 15 Bedded male mountain goat scratching its back with its horns.

C. Fig. 16 Male mountain goat scratching face and neck on the surface of the ground while lying flat on its side.

D. Fig. 17 Male mountain goat scratching its throat on the ground surface while kneeling.

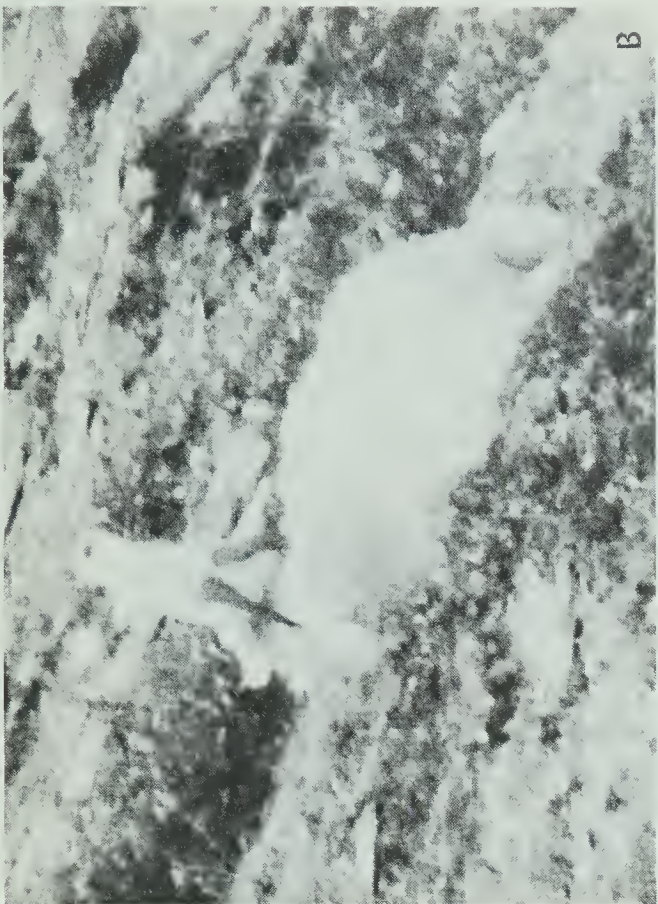
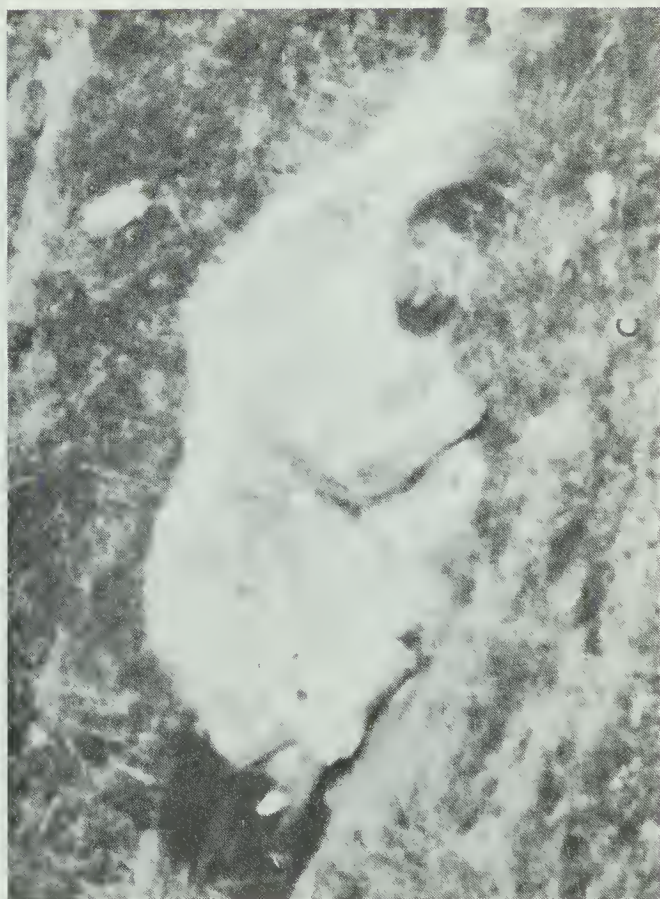
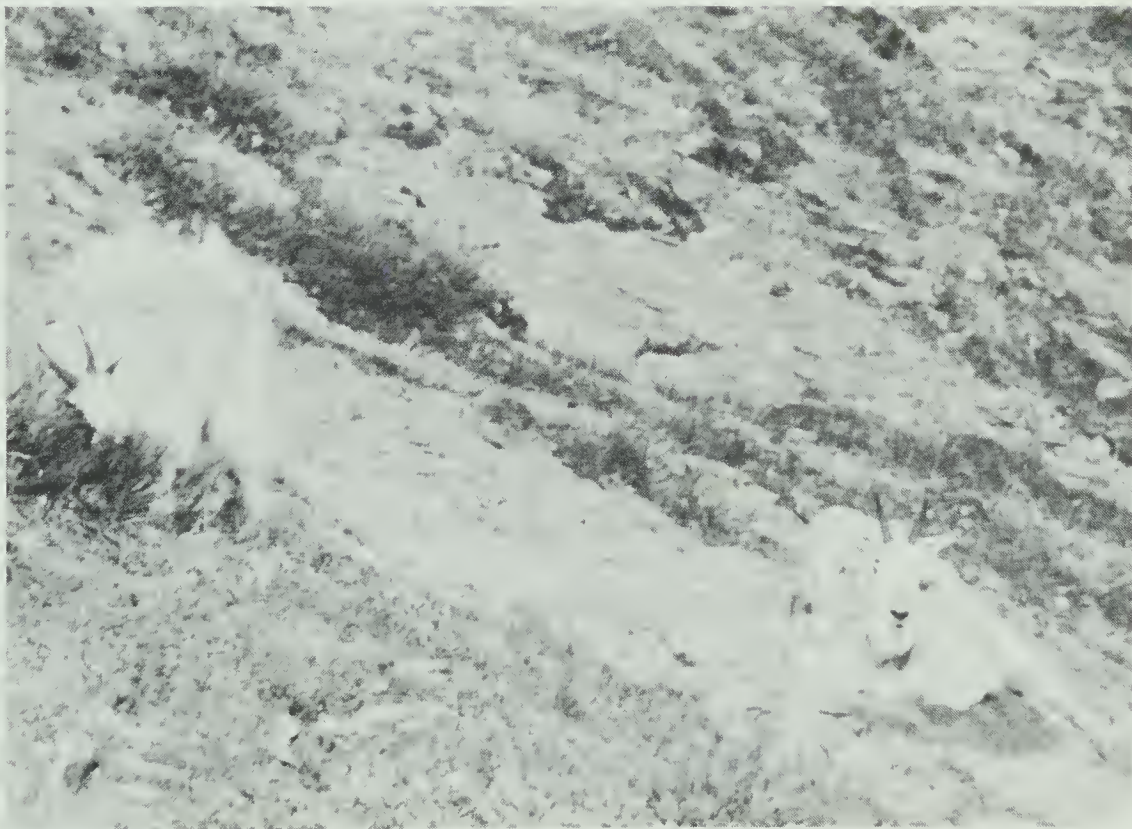


Fig. 18 Male mountain goat slashing a bush with its  
horns.





held straight out. The act is repeated with an abrupt jerk of the head. Bush horning is performed infrequently by all members of the population during the spring and summer. Bushes horned during the spring and summer are not sniffed after horning by any members of the group. Most goats which horn bushes seem to be members of a group.

Bushes are also used for scratching parts of the body. Goats approach a shrub or an occasional pine sapling and rub their bodies on it. Variations of this act are many; for instance, goats occasionally stand close to a shrub and scrape the lower neck and sternum back and forth over the bush (Fig. 19).

Rubbing the forehead and horn bases on a soil bank is generally performed in areas where extensive digging of beds and dirt-baths has occurred. The goat lowers its head and places its forehead and front of the horn bases against an earth bank or hummock as in Fig. 20, the goat then forcibly twists its forehead into the bank.

#### Head and Body Shaking

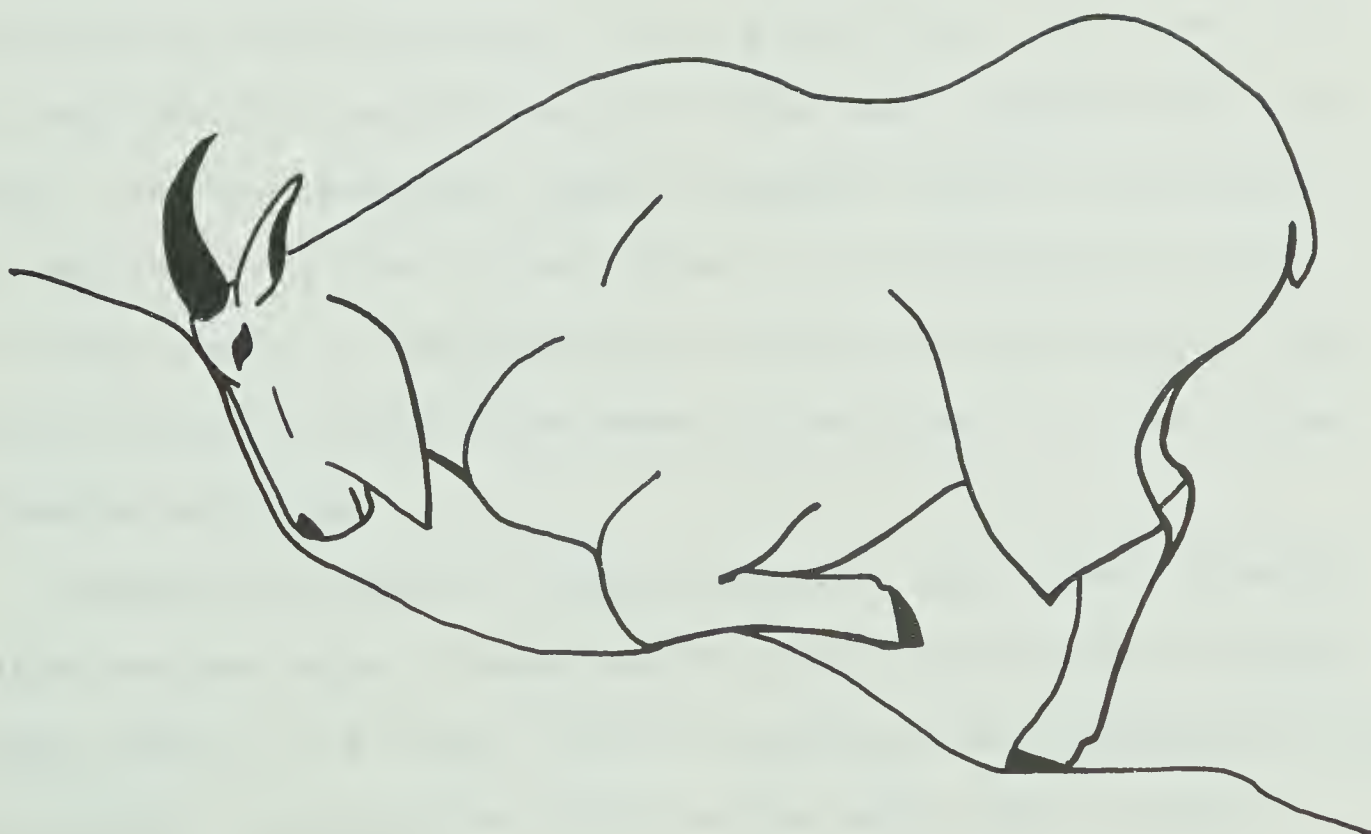
In this act the head and body are shaken vigorously by rapid limited twisting on the longitudinal axis of the body. When the entire body is shaken the movement appears to begin at the head and proceed posteriorly, in a continuous wave of motion. I often saw a cloud of dust or water droplets in the air shaken out of a goats pelage.

#### Bedding Acts

Bedding and bed preparation are basic acts throughout

Fig. 19 Male mountain goat scratching its throat and sternum on a shrub.

Fig. 20 Goat twisting its forehead into an earth bank.





all seasons. While bed preparation in itself is not a comfort act, it is preparatory to one. When preparing to bed down goats first examine bed sites by vision and smell. Then they begin to hollow out a depression 1 to 2 inches deep and approximately 14 by 24 inches in size. They dig with both forefeet, using no sequence or set number of strokes. The goats simply stand over the bed sites and deliberately paw with both forefeet. Occasionally goats will approach and investigate a previously prepared bed, and with little or no attempt to rebuild it they will lie down.

The next stage in the performance is bedding itself. When lying down an adult goat lowers its forequarters, bending the forelegs at the knees while the hind legs remain extended. Once the animal is on its knees, it lowers its rear end and settles down, rolling partially onto one side. Rising from the bed follows much the same sequence as lying down. The forelegs are placed together before the animal and extended so that a goat levers its forequarters erect. It then throws its weight forward onto its forelegs as the hind legs are brought from beneath the body into the normal standing position.

Some variations in the bedding act were observed among males and new kids. Occasionally a kid collapses or simply flops down on its side, the hind quarters being lowered first. During the reproductive season males often bed in their rutting pits. A male which is already sitting in its rutting



pit simply extends a foreleg forward and tucks the other against its chest (See Section 4.2).

Bedded mountain goats assume a variety of positions. Ruminating goats lie with one or both forefeet extended or tucked beneath their sternum and head erect (Fig. 21a). Their eyes are closed, particularly when the animal is facing the sun. On a few occasions goats were lying in the first position described with their head folded back along their side (Fig. 21b). On warm sunny days goats were often seen lying flat on their sides with all legs extended perpendicularly from the body (Fig. 21c); their eyes are often closed. Goats which seemed to be sleeping had their eyes closed and ears laid forward.

#### Dirt-bathing

Dirt-bathing begins in the same manner as bedding until goats are in the lying position. Goats then begin to paw the ground with one forefoot holding the opposite member folded beneath the body. The goat extends its forefoot and sweeps it back with a rapid somewhat lateral motion the last part of which is an upward flick which sprays earth over the groin, back and flank region (Fig. 22). After pawing earth over one side the goat shifts position and repeats the act on the other side using the other forefoot. Occasionally in the initial stages of dirt-bathing a goat props itself up with one foreleg while pawing with the other forefoot.

Fig. 21 Three of the various bedding positions of the mountain goat as shown by a kid and an adult male.

- a) Kid with head erect and forelegs tucked against sternum.
- b) Kid with head folded along its side.
- c) Male goat lying flat on his side.



Fig. 22 Mountain goat performing the dirt-bathing  
act.





### Body Licking

Goats generally pull or lick off a mouthful of wool from their flanks, ribs, or inguinal region by twisting their heads back along their sides and licking or biting their coat. They then eject the wool from their mouths with their tongue. When licking their flanks or inguinal region goats raise their hind legs and move them forward, occasionally lifting the leg until it is nearly parallel to the ground (Fig. 23) and pushing the head beneath the leg and into the inguinal region. Body licking may be performed either while standing or bedded.

Occasionally goats rub or lick the inside of their forelegs. During this act the forelegs are slightly forward of their normal position and spread slightly as shown in Fig. 24. The neck is bowed until the muzzle is in contact with the area to be licked or rubbed.

### Bedding in Snow or Water

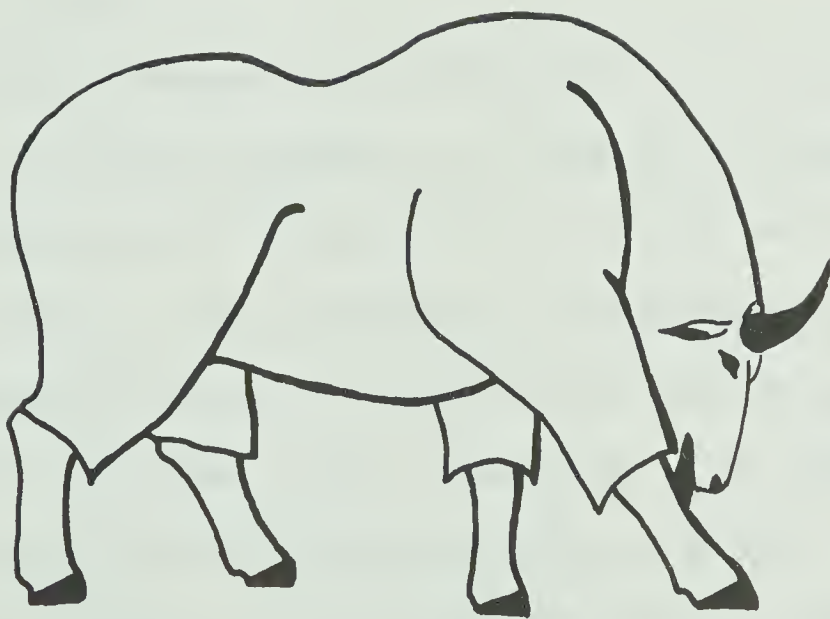
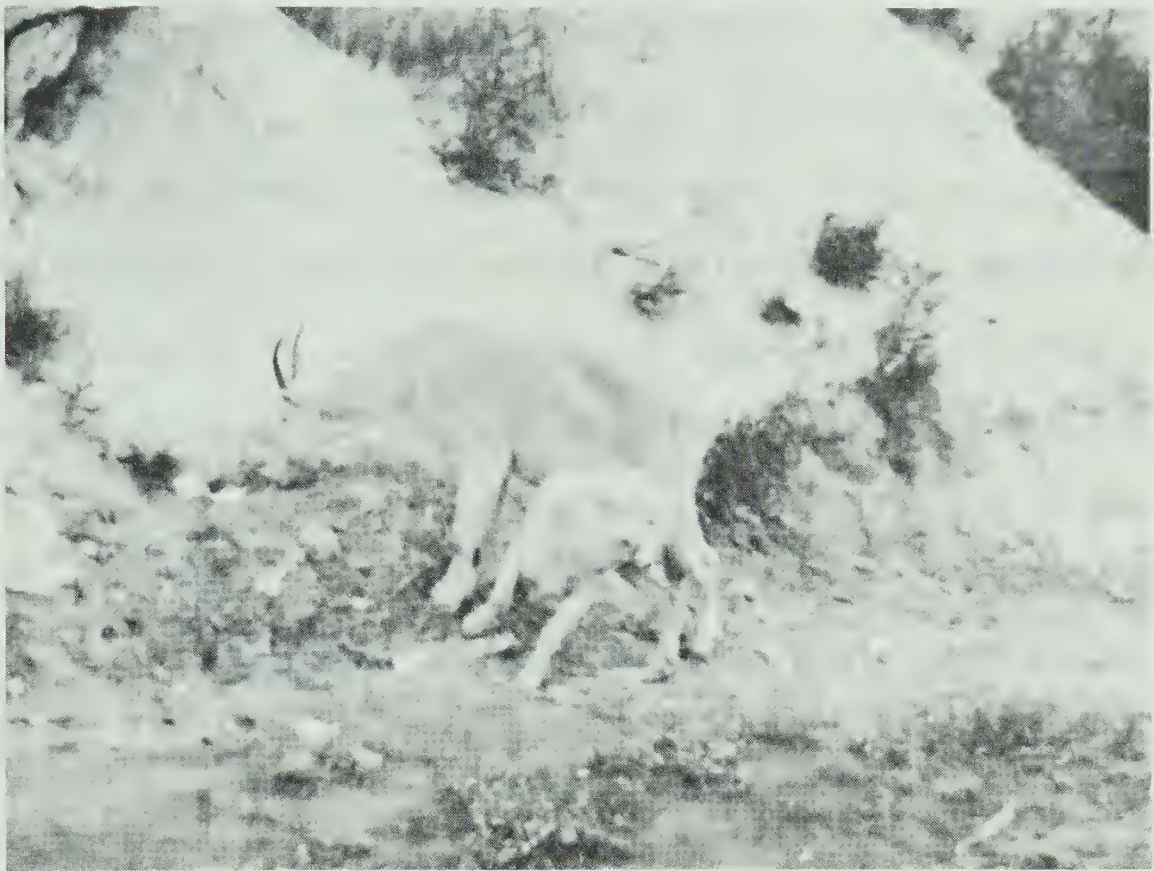
I have observed goats going directly to isolated snow banks and bed on them. This behavior was most frequent when temperatures were high early in the summer and goats still retained most of their winter pelage. I have also observed goats rush down to the quarry mineral lick, where they lie down in a shallow pool of cold water. In these situations bedding occurred without preparation of a bed.

### 1.2 Analysis of Observations

Comfort and maintenance behavior of the mountain goat can be subdivided according to constancy of occurrence into

Fig. 23 Goat kid licking inguinal region. Note hind leg raised parallel to the ground.

Fig. 24 Goat licking and rubbing the inside of lower foreleg.





constant and seasonal types. Constant comfort acts are those performed throughout the year whereas seasonal acts are seen only during certain times of the year.

The most basic comfort acts are the eliminative acts. Both males and females deposit urine and dry, pellet-like feces haphazardly without regard to location. Goats do not cease activities in which they are engaged to defecate, but do so when urinating. Defecation is initiated by a brief raising of the tail. Goats make no effort to avoid walking through, or bedding in soiled areas. Preferred bedding sites are often several inches deep in their pellet-like feces.

Stretching in its multiplicity of forms is a constant comfort act performed by both sexes and all age classes. Yawning must be termed a constant comfort act although it is rarely seen (Table 2).

Scratching movements are variable in form and frequency. Although regarded as a constant comfort act scratching occurs most frequently in spring and summer (Table 2). There is an increase in performance in April, the level remaining high throughout May and June (Tables 2 and 3). All acts other than scratching with the hind foot occur with approximately equal frequency (Table 4).

Various secondary methods of scratching are seasonal. The use of shrubs, trees, and the ground surface for scratching was rare. Bushes are used in comfort behavior for horning and scratching the body, but these acts are rarely seen



Table 2 Comfort acts performed by mountain goats of Kootenay National Park  
(Data from 1967 - 1968)

	January	February	March	April	May	June	July	August	September	October	November	December
Licking or biting the body n = 59	0	2	2	4	6	18	8	15	0	0	1	0
Frequency of act per 100 hours	0	1.0	1.1	1.6	1.3	2.6	1.3	3.4	0	0	.2	0
Stretching movements n = 17	0	2	5	2	3	4	2	0	0	0	0	0
Frequency of act per 100 hours	0	1.0	2.8	.8	.67	.6	.3	0	0	0	0	0
Shaking body parts n = 39	0	1	2	4	9	10	1	4	0	0	8	0
Frequency of act per 100 hours	0	.5	1.1	1.6	2.0	1.5	.16	.90	0	0	1.8	0
Yawning n = 10	0	2	0	0	1	1	0	2	0	1	0	3
Frequency of act per 100 hours	0	1.	0	0	.22	.2	0	.5	0	.5	0	2.7
Total number of scratching acts n = 234	0	4	6	32	48	60	48	32	0	0	4	0
Frequency of act per 100 hours	0	2.1	3.4	13.3	10.8	9	7.7	7.2	0	0	.9	0
Dirt-bathing acts n = 177	0	0	1	0	18	30	69	61	1	0	0	0
Frequency of act per 100 hours	0	0	.56	0	4.0	4.5	11.1	13.7	.8	0	0	0
Total hours of observation	208.5	190.5	178	240.5	445.5	669	621	444.5	121	191	445.5	110.5







Table 4    Frequency and duration of scratching acts in  
             mountain goats of Kootenay National Park  
             (Data from 1968).

	March	April	May	June	July	August	September	October	November
Total number of acts observed	3	29	46	40	11	5	-	0	1
Total number of goats observed	18	38	48	36	21	21	-	0	68
Hours spent in observation	75.5	142	173	134	71	70	-	0	119
Frequency of acts per hour per goat	.0022	.0051	.0055	.0083	.0074	.0034	-	0	.0001
Mean length per act in seconds	15	10.48	8.42	6.38	19.54	5.0	-	0	10.0
Standard deviation	±5.0	±7.2	±5.4	±3.1	±22.7	±2.2	-	0	±0



(Table 3). Afterwards shrubs used are often festooned with streamers of wool (Fig. 25). Horn scratching is a seasonal comfort movement (See Table 3). It occurs in both sexes and in most age classes, (although I saw only one kid attempting to scratch with its horns).

Bedding is a basic and certainly a constant comfort act in goats. Goats tend to bed in groups in rough areas with escape terrain nearby. Goat beds and bedding areas have fairly constant characteristics. In inclement weather goats prefer to bed against cliff faces behind snow drifts which build up there, or in caves when they are available. In fair weather goats prefer to bed on projections with a clear field of view. The bed itself is a platform perhaps large enough to hold the goat and kid. Goats of all ages, including kids, dig beds. In periods of bedding or rumination goats occasionally appear to sleep. During the summer goats often lie flat on their sides for extended periods with their eyes closed and their heads lowered. In winter bedded goats normally keep all limbs close against their bodies.

Dirt-bathing is the most obviously seasonal comfort act in mountain goats. The dirt-bathing pattern of acts can be extremely variable (Table 5). Basic alternative acts of the pattern are bedding, horn scratching of the shoulders and ribs, or scratching the face or chin on the ground. Goats were rarely observed urinating in dirt-baths. After the initial phase of pure dirt-bathing the behavior often develops into a pattern of alternate acts.

Fig. 25 Shrub used for scratching the body. Note  
the streamers of wool left festooned on it.





Table 5    Variability in dirt-bathing patterns of mountain  
goats of Kootenay National Park    (Data from 1968).

	Date	Rubbing face in dirt	Bedding act	Horn scratching shoulders	Changing position	Scratching back of head or neck	Dirt-bathing act	Examining bed site	Pawing out bed site
May	2		1				2		
	8		1	3			2		
	14a						1		
	b		1, 3				2		
	17		4		2		1, 3		
	18		5, 7				6	1, 3	2, 4
	21						2		1
June	8		1				2		
	19		1, 3 5, 7 10	2	8	4	6, 9		
	20a		1, 3				2		
	b		1, 4 8, 11	9	3	5, 7	2, 6 10		
July	4	3					2		1
	9		2				1		
	13a		1, 7		4	3, 6	2, 5		
	b		1	3, 8	6	4, 7	2, 5		
	14a		1	4		3	2		
	b					2	1		
	18		1, 3				2		



Table 5 (continued)

	Date	Rubbing face in dirt	Bedding act	Horn scratching shoulders	Changing position	Scratching back of head or neck	Dirt-bathing act	Examining bed site	Pawing out bed site
July	19a		1	4		3	2		
	b	5	1		4	3	2		
	c					2	1		
	30a		1				2		
	b		2,4,6				3,5	1	
	c		1			3	2		
	d	3	1				2		
	31a		1				2		
	b						1		
	c					2	1		
	d		2				1,3		
	e						1		
August	1a						1		
	b		3				2		
	6		1	6	3	5	2,4		
	7	2		3		4	1		
	8	5	2,4				3		1
	9a	3	1,4			5	2		
	b		1,5				2,6	3	4
	c		1				2		



which may be performed in a variable sequence (Table 5). In Table 5 the acts of dirt-bathing bouts are listed in order of occurrence: for example, if bedding is the first act performed in a bout it is listed as number 1; if horn scratching is the second act it is number 2, and similarly the sequence of the acts are numbered. The only relatively stable components of the pattern are bedding which is the first act in 50 per cent of the bouts; and dirt-bathing, second in 60 per cent of observed bouts. The remaining acts are variable in the overall sequence. Frequency and duration of the individual bouts are also variable (Table 6).

Licking the body surface is a type of grooming or maintenance behavior commonly observed throughout the year. Shaking is another act which must be termed a constant grooming act. Shaking does not occur at a constant frequency throughout the year (Table 2) but shows an increase during May and June. It occurred most often when the fur was wet or the goat was rising from a bed or dirt-bath.

### 1.3 Discussion

#### 1.3.1 Eliminative Behavior

Sexual dimorphism in urination postures such as found in the mountain goat also occur in the bighorn sheep (Geist 1966). The constancy of the urination posture in female sheep and goats suggests that the posture has a purpose other than simply being involved in voiding urine. Hafez, Williams, and Wierzbowski (1962) reported that exaggerated urination stances in horses with foals, prevents urine



Table 6 Frequency and duration of dirt-bathing in mountain goats in Kootenay National Park. (Data from 1968)

	January	February	March	April	May	June	July	August	September	October	November	December
Total hours of observation	208.5	190.5	178	240.5	173	134	71	70	121	191.5	119	110.5
Total observations of dirt-bathing behavior	0	0	1	0	15	22	63	59	0	0	0	0
Frequency of acts per hour per goat	0	0	0	0	.0005	.0013	.0087	.0048	0	0	0	0
Mean length per dirt-bathing act in seconds	0	0	0	0	26.75 n=4	23.83 n=6	10.62 n=13	10.43 n=7	0	0	0	0
Standard deviation	0	0	0	0	±18.14	±24.52	±4.96	±2.37	0	0	0	0
Mean number of acts per bout of dirt-bathing	0	0	0	0	3.14 n=7	6.50 n=4	3.26 n=19	3.60 n=10	0	0	0	0
Standard deviation					±1.95	±4.65	±1.91	±1.58				
Mean length per bout in seconds	0	0	0	0	34.75 n=4	96.25 n=4	53.54 n=11	22.60 n=5	0	0	0	0
Standard deviation					±12.80	±91.45	±57.29	±13.61				
Frequency of bouts per hour per goat	0	0	0	0	.0005	.0008	.0074	.0038	0	0	0	0



contamination of the skin of the udder. I suggest that the squatting urination posture of the female goat prevents urine from contaminating the udder, which might be detrimental to the survival of the young.

Use of soiled beds seems to be a common attribute of several bovids such as mountain goats, domestic sheep and goats and bighorn sheep (Pers. obs.). In most cases the animals are not soiled because of the dryness of the feces. While mountain goat beds had a deep accumulation of feces, the sites did not seem to serve any other purpose other than a preferred bedding site.

#### 1.3.2 Stretching and Scratching Behavior

Geist (1966) suggested that scratching was of little importance in the comfort behavior of mountain goats since they dirt-bath. I found scratching behavior to surpass all other types of comfort behavior in frequency of occurrence. Scratching with the hindfoot whether standing or bedded is the most common method of scratching, and makes up 44 per cent of all comfort acts (Table 3). I have observed bighorn sheep and domestic goats scratching with the hindfoot in precisely the same manner as I described for mountain goats. The mountain goat does not scratch with the same delicacy as in the bighorn sheep or domestic goat.

Bush horning in the summer exhibited a degree of social facilitation within the band. One goat horning a bush seemed to stimulate others to do likewise. Since the act occurred within groups of goats it may represent an



agonistic or stress reaction. However, I did not observe anything suggesting threat or reaction to an agonistic situation. The bush horning act was without visible sexual overtones since all group members participated.

Scratching on bushes or soil banks seemed to be in response to irritation caused by small flies congregating about the forehead and horn bases. Flies may also stimulate bush horning. Flies did stimulate ear flicking and foot stamping by the goats.

### 1.3.3 Scratching Stimuli

There appeared to be two reasons why mountain goats scratched more during the spring and summer. First, irritation caused by biting insects and ticks\* (*Dermacentor andersoni*) around the head, neck, jaw and ears probably caused the more frequent and prolonged scratching shown in Table 4. Horn scratching appeared to be in response to irritation caused by ticks. I have observed wither scratching in bighorn sheep in spring and summer; they were scratching areas on their shoulders which were visibly encrusted with scabs. Tick infestations coincide with the height of scratching in mountain goats, at which time I found it easy to collect ticks. By mid-July ticks had disappeared as is indicated by the decrease in scratching. Secondly, goats were molting throughout the scratching period. They often scratch wool from their neck and

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\*Three goats examined immediately after death were found to be infested with ticks.



shoulders with their hind feet as well as using bushes. Shedding of winter pelage itself seems to cause discomfort to which goats respond by scratching.

#### 1.3.4 Bedding Behavior

My observations suggest that in some cases goats may actually sleep. Such behavior has been reported in domestic sheep and goats (Hafez and Scott 1962) however, these authors considered that most ruminants sleep very little, if at all. It is improbable that mountain goats do more than sleep lightly because this would leave them easy prey for such predators as black bears (*Ursus americanus*), grizzly bears (*Ursus arctos*) and cougars (*Felis concolor*), all of which range on Mount Wardle.

Many of the previously cited comfort acts are associated with the bed or the acts of lying down or getting up. There are certain parts of male reproductive behavior still to be described that also appear to have some connection with the bed.

#### 1.3.5 Body Surface Maintenance

Body licking is widespread in mammals. I have observed domestic cattle, sheep and bighorn sheep groom their coats by licking. In the species cited, licking behavior seems in response to molting pelage or irritating substances such as soil, feces, urine and mud. Body licking may have some adaptive value. For example females which lick the lower abdomen, particularly while nursing, keep their teats clean, this may be of importance in the well being of suckling



young. Licking the lower abdomen may also be a response to biting insects and ticks, particularly in goats in which the udders and inguinal region are nearly naked.

Situations in which pelage shaking occurs are: immediately on rising or when the pelage is wet and soiled. Body shaking appears to be an effort to rid the body surface of foreign matter and to rearrange the pelage. Goats appeared to shake themselves to eliminate snow, soil or accumulated water from their pelage.

#### 1.3.6 Dirt-bathing

A major component of the dirt-bathing pattern in mountain goats is scratching the face, neck and back of the head with the hind foot. Kraemer (Pers. comm.) has suggested that scratching the back of the head may constitute marking because after scratching the goat replaces the hind foot in the bathing depression, thus the secretion from the occipital glands is carried to the bathing depression. I disagree because of approximately 30 goats observed specifically to determine if they were touching their occipital glands while scratching, none were observed doing so. To pick up an odoriferous substance from the occipital glands, the goat's foot must touch the glands directly. The occipital glands are thought to be active only during the rut (and only in males) (Brandborg 1955). During the rut twigs and grass stems are passed over the occipital glands. No scratching was done at this time.

The final component of dirt-bathing patterns is



scratching the chin, throat and face on the ground surface around the bedding depression. Scratching the chin, throat, head and neck could be expected of a goat in a dirt-bath since the areas scratched are not touched with the soil pawed in the dirt-bathing act.

There are several social situations and some conditions of the surroundings which appear to influence performance of the dirt-bathing pattern. Preferred bathing sites are often close to or part of preferred bedding sites and are often in fine skree, gravel, dust, or areas of deep moist soil. Areas such as these seemed to stimulate dirt-bathing in goats which were passing through or were feeding in the vicinity. In addition dirt-bathing areas used during the hotter parts of the day had substantial amounts of shade on or near the site. Many goats preferred sites exposed to wind.

Other factors appear to influence the incidence of dirt-bathing and related acts. There may be some social facilitation in that one or more bathing goats seem to stimulate nearby goats to bathe. There also appeared to be an increase in bathing in situations suggesting unusual stress. A band of goats moving down to the mineral licks shows increased restive, agonistic, and investigative behavior. Downslope movement is slow and cautious with frequent halts during which the goats carefully examine the area below. During these examinations goats quickly reacted to my slightest movement or that of any other potentially



dangerous animal. Upon arriving at the mineral licks there was much dirt-bathing and apparently more agonistic behavior. It is possible that the mountain goat shows altered behavior in unnatural or stressful situations. The incidence of dirt-bathing also appeared to increase with a rise in ambient temperature. On hot days much of the dirt-bathing took place in shaded areas. I suggest that dirt-bathing is a comfort movement that occurs in response to heat, irritation by skin parasites, and the discomfort of the molting pelage. The pattern may also be elicited in response to stress. Scratching plus dirt-bathing in the fine and occasionally moist earth may be soothing to irritations in all the above situations.

#### 1.3.7 Bedding on Snow Banks and in Water

Bedding on snow banks seemed to be in response to high ambient temperatures combined with retention of winter pelage. I have observed bighorn sheep lying on snow banks in windy exposed areas. I suggest that these animals show a preference for high open basin and ridges in an attempt to remain in cooler areas with fewer biting insects. Both bedding in snow and water may accomplish the purpose of cooling and soothing the animals.



## 2. SOCIAL STRUCTURE AND BEHAVIOR

The mountain goat population on Mount Wardle appeared to consist of two loosely maintained subpopulations with little apparent cohesion within the subpopulations. They could and did split into individuals and small groups. The two subpopulations were the a) adult male and b) female-young groups. Male groups consisted of adult males only; female-young groups consisted of adult females and young of both sexes (including subadult males, 3-years-old or less).

There were few interactions between the male and the female-young groups mainly because the two subpopulations used different sections of the wintering area. Male groups used the high easternmost and westernmost portions while the female-young groups remained mostly on the central portions of the southern slopes. Both groups used the same summering areas with few interactions since the groups generally remained apart. Adult male groups seemed to split into small groups or individual animals. Each group visited mineral licks at different times thus encounters between the two subpopulations were rare.

The social interactions of mountain goats are often aggressive. Geist (1965) recognizes three threat types: the horn threat, present threat, and rush threat, as well as an aggressive movement, the horn swipe. Geist (1965) also describes a submissive movement which he termed the conflict posture. Geist (1965) differentiated between



present threats used by males and females. I also recognized another type of threat, a stare threat; and another type of submissive behavior (See below).

## 2.1 Description of Threat and Submissive Behavior

### 2.1. Threat Behavior

#### a) Horn Threat

In the horn threat goats lower their heads, pull in their chins and tilt their horns toward their adversary (Fig. 26) (cf Geist 1965).

#### b) Stare Threat

In the stare threat goats stand facing and staring intently towards their adversary with head, held high and erect and ears forward (Fig. 27). The muzzle is held slightly below the horizontal. Stare threats are normally restricted to adult females.

#### c) Present Threat

A female performing a present threat approaches its adversary and assumes a position parallel to it. The head is lowered and the horns are directed laterally and anteriorly (Fig. 28). The aggressor then begins to sidle towards her opponent. Normally a threatened goat moves aside or flees when approached in the above manner. Female present threats appear to be of lower intensity than those of males during the reproductive season (See Sec. 4.2).

#### d) Rush Threat

The rush threat may be performed by either sex at any age. When performing the rush threat the aggressor rushes

Fig. 26 Female mountain goat performing a horn threat.  
Note, the threatened goat has assumed a conflict posture in face of the threat.

Fig. 27 Female goat performing a direct stare threat.  
Note, the threatened goat has assumed an avoidance position and that the threatening goat has badly broken horns.

Fig. 28. Female goat performing a present threat.





directly at its opponent. When nearing its adversary the aggressor lowers its head slightly and if the opponent has not fled a horn swipe ensues.

#### e) Horn Swipe

The horn swipe is a short upward swipe of the head with the horn tips tilted forward (Fig. 29). Rarely does an aggressor injure an opponent with a horn swipe, as the horns are either swept by the other goat if it has not already fled or the latter flees before the swipe can be completed (cf Geist 1965).

### 2.1.2 Submissive Behavior

Fleeing is the most common reaction to threat. A second solution in which the animal stands and gazes away at right angles to the threatening goat appears to be a type of avoidance behavior (Fig. 27). A third method of avoiding aggressive action is to assume a conflict posture which is used by both sexes (cf Geist 1965) (Fig. 26). In the conflict posture the animal assumes a partially crouched position with the horns pointed directly away from the aggressor, the side of the face and throat are completely exposed to the aggressor.

## 2.2 Analysis of Observations

### 2.2.1 Social Subdivisions

#### 2.2.1.1 Male-male interactions and movements

The adult male group appears to be a largely autonomous segment of the goat population on Mount Wardle. Male groups remain on the edges of the wintering area, along the timber

Fig. 29 Goat performing the horn swipe.





edge, generally some distance from escape terrain such as broken ledges, cliffs, and rock slides. There are few group interactions or incidents of aggressive behavior outside of the reproductive season (Fig. 30). Agonistic interactions are mostly settled by horn threat and retreat.

Mean size of the male groups increase after the males separate from the females and young at the end of the rut, (Fig. 31). Female-young groups visit male wintering areas infrequently and only under conditions of little or no snow. In late spring there is some movement of males along the Vermilion Range and an increased number of penetrations of female-young groups into male wintering areas.

Throughout the summer males visit mineral licks infrequently (Table 7). Their use of licks decreases rapidly from early summer; by August their visits are rare. Adult males generally move down to mineral licks in late evening or early morning. At the height of lick use males are also moving higher on the wintering area. Male groups visiting the mineral licks rarely encounter female-young groups.

Mountain goats begin to move to the summering areas as soon as large snow free areas appear, making travel over trails possible. Along the Vermilion Range some northward movement occurs over crusted snow, but I believe that it is limited to adult males. Males preceded females and young into the summering areas.

Fig. 30 Number of observed male-male aggressive interactions per month (Based on all threat types).

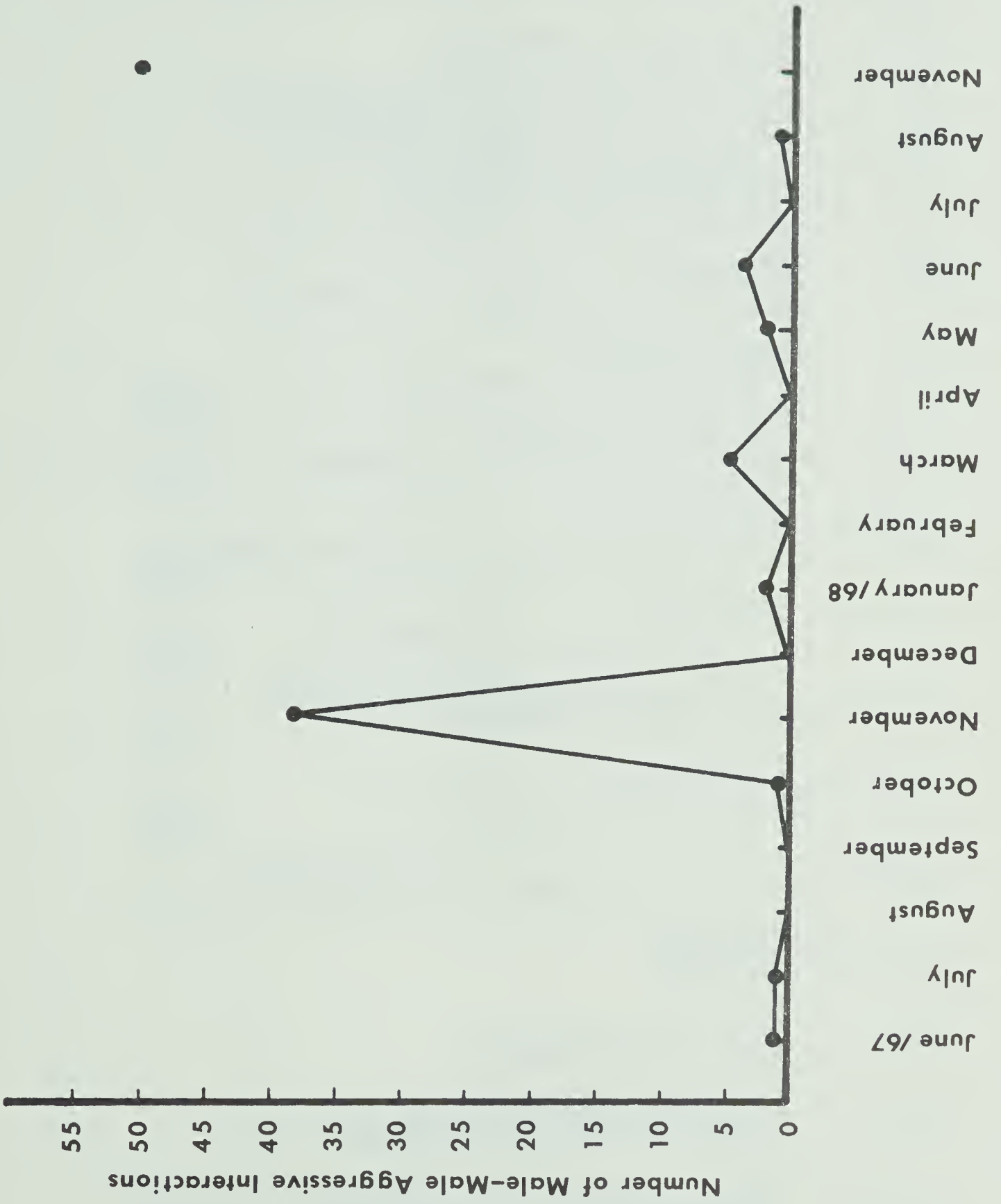
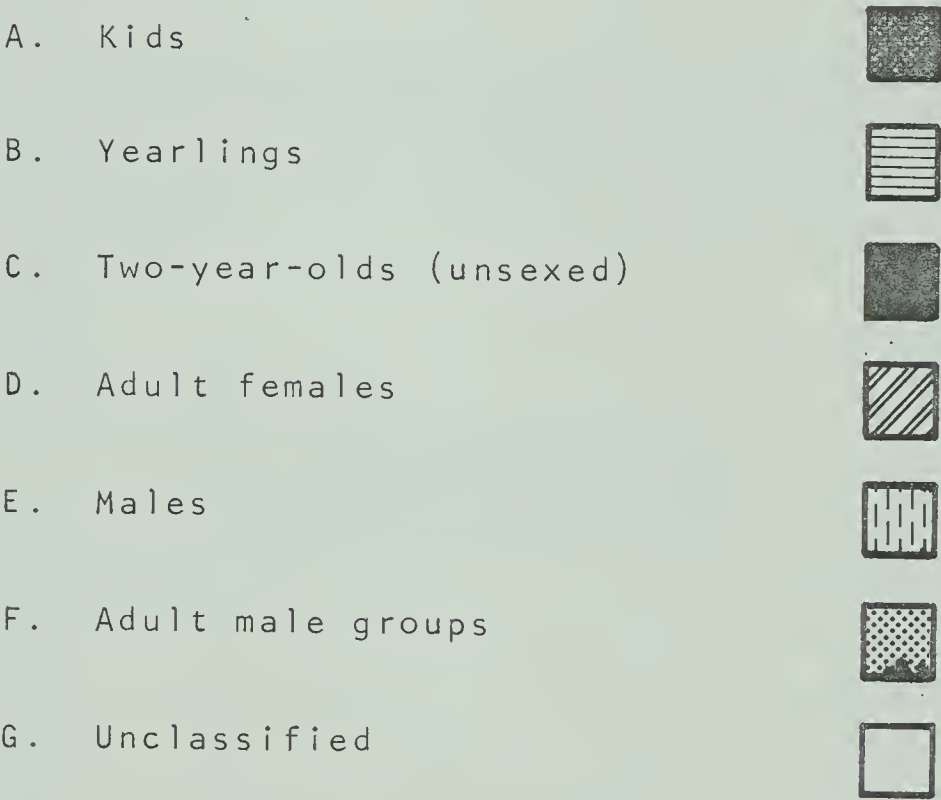


Fig. 31 Mean group sizes and composition for female-young groups and mean group sizes for adult male groups.



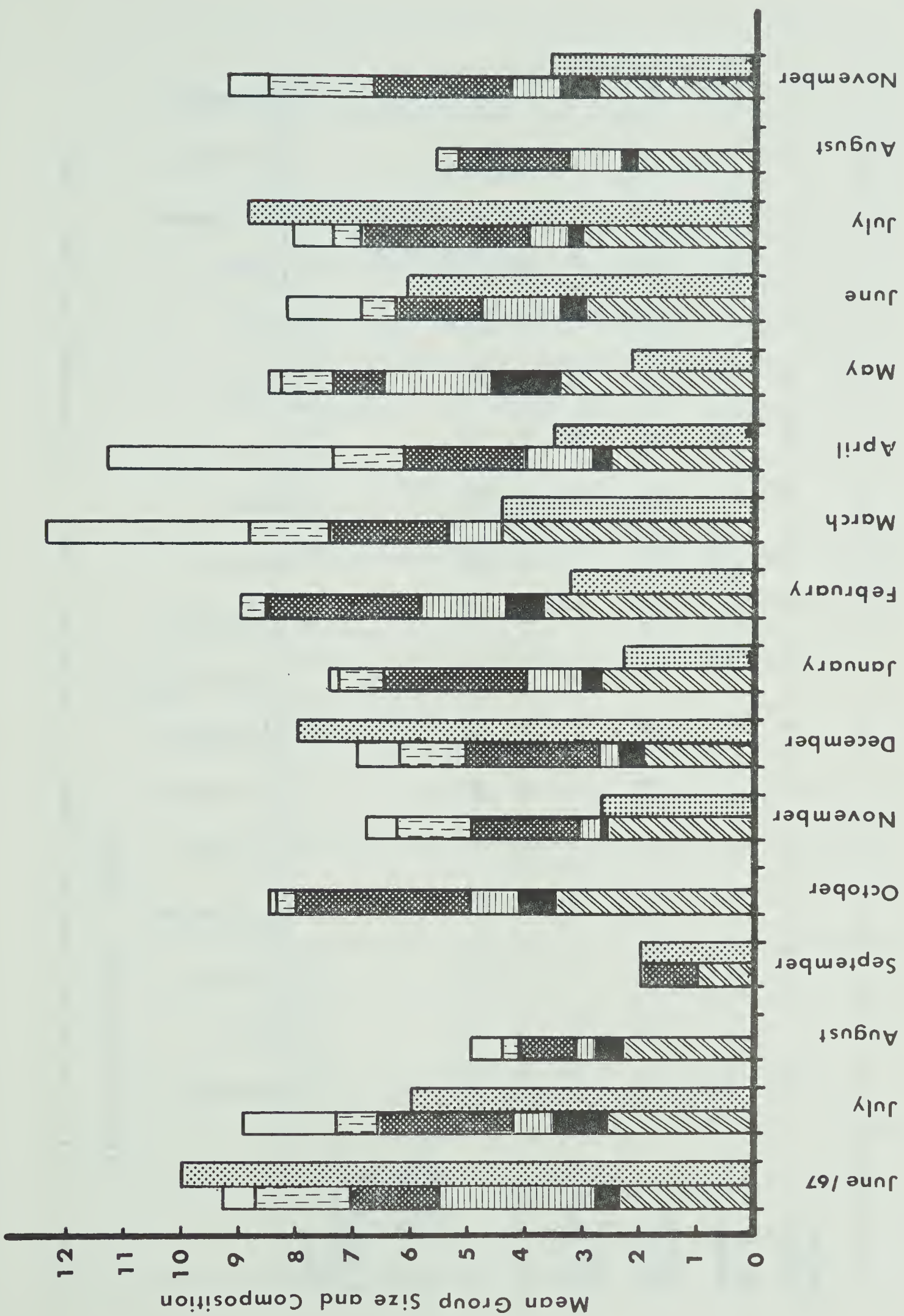




Table 7 Visitation of mountain goats to mineral licks in Kootenay National Park throughout 1967 - 1968.

	June/67	July	August	September	October	November	December	January/68	February	March	April	May	June	July	August	September	October	November
Total numbers of visitors	153	179	197	9	4	5	2	5	34	29	77	285	614	281	151	-	-	20
Percentage of visitors																		
Kids	13	34	36	33	0	40	50	0	23	28	48	0	16	35	31	-	-	32
Yearlings	34	11	8	0	100	20	0	60	18	21	21	16	25	13	21	-	-	5
two-year-olds	7	11	5	0	0	0	0	20	5	4	0	19	7	3	4	-	-	4
Adult females	21	36	40	33	0	40	50	20	36	34	28	50	39	43	36	-	-	32
Subadult males	10	5	4	0	0	0	0	0	10	13	3	5	4	3	6	-	-	18
Adult males	16	3	4	33	0	0	0	0	8	0	0	10	9	3	2	-	-	9



The winter concentrations of males break up and small groups disperse widely over the summering areas. Any large group of males in June and July are usually moving to or from the mineral licks (Fig. 31).

Intra-group interactions remain placid until late fall when adult males begin to reappear on the wintering area (Fig. 30). Males begin shifting from the same threat behavior as is seen commonly in females to threat types characteristic of males in the reproductive season (See Sect. 4.2).

#### 2.2.1.2 Female-female interactions

Females are loosely gregarious throughout the year except for a short period during the kidding season when they are semi-solitary. Mean group size and composition varies throughout the year (Fig. 31).

Females seem wary of the approach of other members of the group. Degree of response or type of response varies with time, place, situation, age and condition (i.e., pregnant, lactating, etc.). In a confrontation females may react by threatening with varying degrees of intensity and success or more frequently by performing one of three basic submissive acts.

The presence of kids seems to be a major cause for aggressive interactions between females. Lactating females whose kids are approached by other goats react vigorously with rush threats, generally dispersing the intruders. There are aggressive interactions between females when one attempts



to interrupt kids at play, the other mothers immediately react as if their kids are threatened.

Frequent interactions occur over limited resources such as mineral licks or dirt-bathing areas. Agonistic situations are generally resolved with a horn threat and submissive behavior. Bedded females are extremely wary of the approach of another female particularly from behind or above; they invariably spring to their feet and whirl around to threaten the offender.

Goats visit mineral licks extensively from early May throughout late summer. Use decreases throughout August until October when visitation normally ceases (Table 7). In mid-summer, depending upon snow conditions, the female-young groups move onto summering areas on the Vermilion Range (Fig. 31). Female-young groups return to visit mineral licks on Mount Wardle several times before returning to the wintering area. Twelve females which could be identified were observed several times throughout the summer on the mineral licks, indicating that their visitation although irregular usually occurs several times over a summer. When visiting mineral licks female-young groups remain in the vicinity for one to several days before returning to the summering areas.

#### 2.2.1.3 Female-male interactions outside of the reproductive season

The only males which have consistent interactions with females are the subadult 2-or 3-year-old males remaining with the female groups. Within female-young groups young males were



not discriminated against, being threatened in much the same way as nonlactating females. They are threatened when they approach a kid or its mother too closely.

Outside the reproductive season adult males and females appeared indifferent to the others presence. Females are incapable of displacing adult males or for that matter subadult males with any more than approximately 50 per cent success (Table 8). In one series of observations one young male won 21 consecutive interactions with four different females.

Females employ the same type of threats toward males as are used on females, both of which react the same way. Young males seem to use conflict postures less frequently than adults, but used them often in situations arising from sexual interactions outside the rutting season. I never saw young males approaching nonlactating females in a sexual manner.

Beginning in late October male-female interactions increase in frequency as adult males infiltrate female-young groups (Fig. 31), and begin seeking out females (Fig. 32). With cessation of the rutting season early in December, the number of male-female interactions decrease although some males remain with the female-young groups (Fig. 31).

#### 2.2.1.4 Female-young interactions

A high proportion of interactions in the mountain goat, aggressive or otherwise, are between females and young. This is true even excluding maternal behavior. Of 307 interactions summarized in Table 8, 56 per cent were between females and young. Based on analysis of aggressive interactions (Table 8)

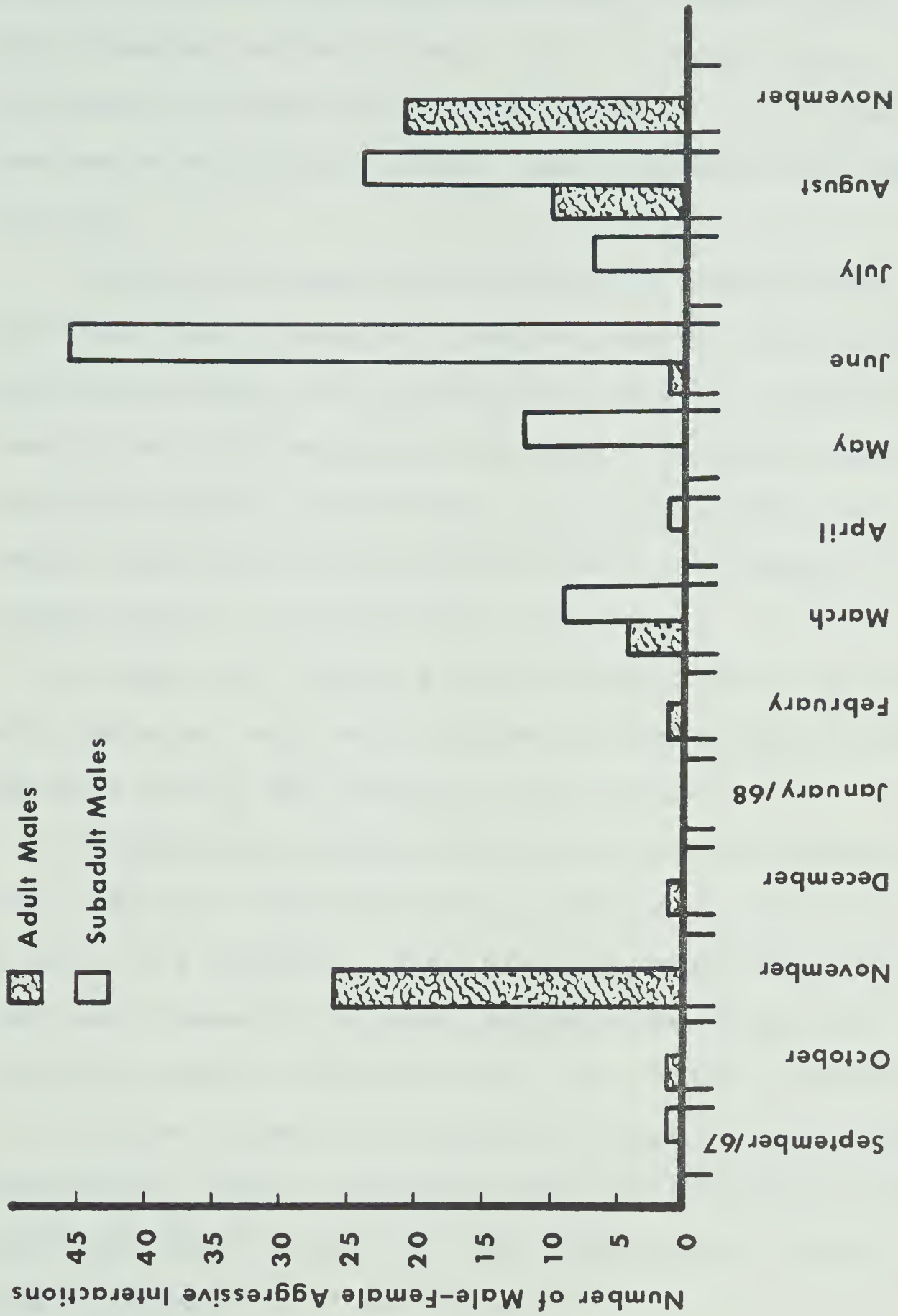


Table 8    Ranking of social subgroups of mountain goats of Mount Wardle based on aggressive interactions outside of the reproductive season (Data from 1967 - 1968).

		Losers				
Winners		Kids	Yearlings	Two-year-olds	Adult females	Subadult males
	Kids					
	Yearlings	100% n=30*				
	Two-year-olds	100% n=4	100% n=7		6.1%	
	Adult females	100% n=39	100% n=90	93.9% n=33		52%    50.8%
	Subadult males	100% n=6	100% n=21	100% n=9	48.0% n=102	
	Adult males	0% n=0	0% n=0	0% n=0	49.2% n=66	

\*n is the total number of encounters between the particular sexes or age classes.

Fig. 32    Frequency of male-female interactions over one year.





there is a linear dominance with age in female-young groups. Adult females dominate 2-year-olds in 94 per cent of all encounters, younger animals are dominated in all encounters. Two-year-olds dominate younger goats and yearlings dominate all kids.

Females are generally antagonistic towards young other than their own, though to a varying degree. Lactating females are more tolerant than nonlactating females. Belligerence towards new kids decreases with time. First meetings of lactating females and strange new kids generally result in the female repelling the kids with a short rush threat. Kids seemed capable of recognizing rush threats. I saw no female or any other goat injure a kid although I found one kid dead with abdominal wall and diaphragm pierced through to the thoracic cavity, as though by a horn swipe.

Female-young interactions often occur in connection with kids playing. The first few play bouts are quickly disrupted by the kid's mothers. After kids have associated for about two weeks frequency of play disruption by females declines. Lactating females often let kids play in their immediate vicinity but strange kids are not allowed to touch them. Occasionally lost or separated kids are allowed to follow a lactating female other than their own dam but usually the female attempts to drive them off.

Strange yearlings are always driven off, particularly when the dam has a new kid at heel. Two-year-olds and all other goats are kept away from new kids. Nonlactating



females whether with yearlings or otherwise are hostile toward strange kids and yearlings.

#### 2.2.1.5 Male-young interactions

For the most part males ignore young goats. Subadult males and young within a female-young group appear to avoid each other. Kids within range of a subadult male are horn swiped or horn threatened and thereafter ignored. Young males seem mildly intolerant of nannies and young.

Throughout the reproductive season there are occasional encounters between adult males and subadult males. Adult males seem intolerant of young males; in any encounters they are threatened and driven off.

#### 2.2.1.6 Young-young interactions

It seems that within a year of birth goat kids develop the aggressive behavior of the adults. Yearlings seem to become intolerant of one another's close proximity. When one is approached by another it uses one of the threats used by adults. Yearlings seem to mistrust each other and are hostile toward new kids. They generally try to horn swipe new kids and continue to do so until the dam drives them off.

Two-year-olds seem intolerant of yearlings and new kids but only in close proximity. They do not approach younger goats to threaten or horn swipe them.

### 2.3 Discussion

Separation of the sexes for most of the year occurs in bighorn sheep (Geist 1966) as well as mountain goats. Male mountain goats also move onto their summering areas before



the females and young as do bighorn rams (Blood 1963).

Female intra-group behavior in mountain goats always suggests some degree of aggressiveness in any interactions. Except for the rut, when males show increased aggressive behavior (Fig. 30), male groups are relatively placid.

Threat behavior in the mountain goat involves demonstration of body size or presentation of the weapons (i.e., the horns), while submissive behavior involves fleeing or suppression of the presentation of weapons. Subordinate behavior of goats is relatively simple. Motivation appears to be avoidance of injury or of ambivalent situations which might result in injuries.

Sensitivity to approach from behind in the mountain goat suggests two things, first that goats depend extensively upon vision for detection of danger (cf Brandborg 1955 and Kerr 1965), and second, there is a mutual distrust among goats. Since the eyes are on the side of the head the animals have panoramic vision but cannot see directly behind. Horses, which have similarly placed eyes are also wary of approach from behind (Hafez *et al.* 1962).

A third possible explanation for the sensitivity of goats to approach from behind is the shape of their area of tolerance. Goats are relatively tolerant of frontal approach which suggests that their tolerance distance in front of their body is much closer than their tolerance distance from behind.



### 3. PLAY IN THE MOUNTAIN GOAT

The young of mammals, particularly those with lengthy periods of parental care as in the mountain goat, often show a great capacity for play, which in goats is retained throughout their lives. Poole (1966) described play in mammals as largely, "adult patterns of behavior which are normally used to promote the survival of the individual but appear in play out of their context". In my work play is defined as in Poole (1966), "an activity which is not oriented towards a goal which is directly concerned with the survival of the individual".

One can divide play of mountain goats into two general forms; a) solitary, and b) associative, wherein two or more goats are involved. The latter is also distinguished by greater complexity.

#### 3.1 Description of Play Acts

##### 3.1.1 Solitary Play

###### A) Vertical leap

Goats performing the vertical leap throw themselves up on their hind legs or into the air or both (Fig. 33).

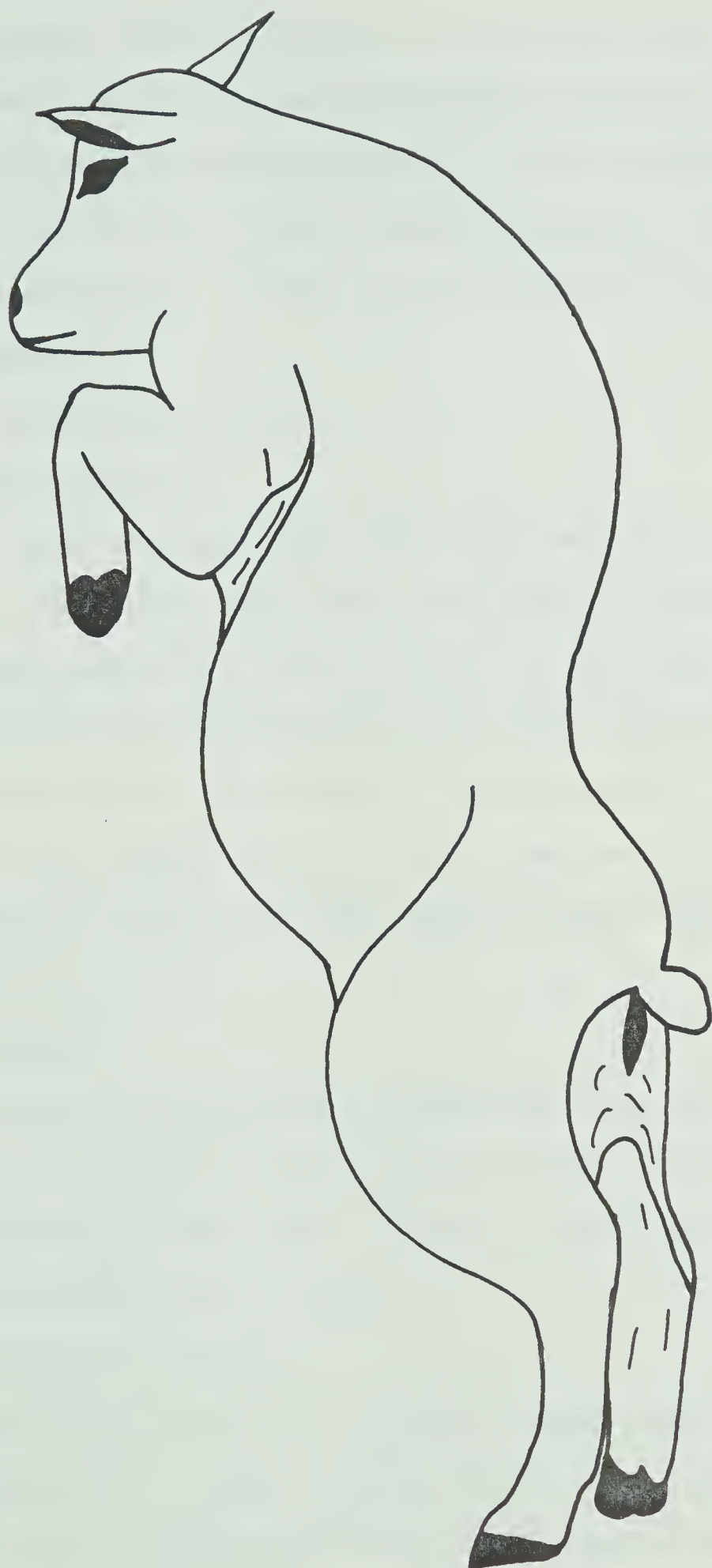
###### a) Leap and spin

After leaping into the air a goat attempts to spin on its long body axis by a violent twist of the head and forequarters.

###### b) Head shaking

Goats performing this act rear up on their hind legs while shaking their head vigorously from side to side.

Fig. 33 Mountain goat kid performing the vertical leap.





## B) Exploratory behavior

The second basic component of solitary play seems to be based on exploration. Kids move short distances from their mothers (rarely more than 20 feet) touch an object with their nose then rush back to their mothers playfully running, leaping, and bucking. After a brief pause this pattern may be repeated.

### 3.1.2 Associative Play

#### A) Mutual butting

Kids stand beside each other head end to hind end (Fig. 34), they butt laterally and upwards into each other's rumps. Their heads are held low and to the side, their muzzles are twisted outwards so that the top of the head is directed towards the flank of the play-mate. Butts are delivered with enough force to lift the rump of the play-mate. Kids butting each other remain close together while revolving in a circle.

#### B) Mounting

The mounter approaches the mountee from behind, rears up on its hind legs and clasps the mountee around the flanks with its forelegs (Fig. 35). Pelvic thrusts were never observed in this type of play.

#### C) King of the castle

"King of the castle" is played around some small elevated position (stump, boulder etc.). One or more kids stand atop the elevated position while others attempt to displace them. They butt and crowd to force each other from

Fig. 34 Kids performing the mutual butting act.

Fig. 35 Kids performing play mounting.





the position in dispute.

#### D) Neck fighting

One kid stands at a right angle to, and with its head and neck across the back or shoulders of its play-mate (Fig. 36). The former attempts to force its play-mate to its knees or force its head down by increasing pressure across its neck or shoulders. The play-mate strives to maintain its position against the pressure exerted by its congener or moves out from beneath the neck of the congener.

### 3.2 Analysis of Observations

#### 3.2.1 Solitary play

Following parturition, dam and kid remain in seclusion for several days; during this period initial play patterns are developed. Initial play attempts are hesitant and short (Table 9).

Initial play is primarily organized around the vertical leap. I have observed 24-hour-old kids trying to do the vertical leap, they simply try to rear up on their hind legs. Later kids incorporate spinning and head shaking into the vertical leap, as well as leaping more vigorously. Kids can leap vertically approximately 18 inches off the ground but generally they simply rear up on their hind legs. When leaping and spinning kids leave the ground, this is not necessarily so when they perform the head shaking pattern. Since leaping play is frequently performed on steep slopes kids commonly loose their footing and fall.

Fig. 36 Kids engaged in the neck fighting pattern of play.





Table 9 Dynamics of play in the mountain goat kids of Kootenay National Park

	May/1967	June	July	August	September	October	November	December	January/1968	February	March	April	May	June	July	August	November
*Total number of observed play bouts	4	6	3	1	0	1	2	3	0	2	7	6	12	60	19	4	4
Number of solitary play bouts	4	5	0	0	0	0	0	1	0	0	2	1	7	23	1	1	1
Number of associative play bouts	0	1	3	1	0	1	2	2	0	2	5	5	5	37	18	3	3
Mean number of play bouts per kid per day	-	-	-	-	-	-	-	-	-	-	-	-	1.2 n=4	1.7 n=16	.1 n=10	.1 n=9	-
Standard deviation													±2.5	±1.9	±.31	±.3	
Mean length of play bouts in seconds	-	-	-	-	-	-	-	-	-	-	30.0 n=1	28.0 n=3	4.4 n=5	143.2 n=32	690 n=4	23 n=1	20.0 n=2
Standard deviation											±15.4	±1.7	±174.5	±542.2	-	-	±0
Total hours spent in observation	109	276	289	136	121	192	222	111	209	191	178	241	336.5	333	334	308.5	224

\*Play occurring in 1967 is not directly comparable to 1968 due to change in observation techniques (See page 17).



In exploratory play the dam functions as the base from which kids move out to examine their environment. I do not feel that kids are reacting in fear when they rush back to their dams, since they are slow to frighten when confronted by strange objects. Kids have approached me to within 20 feet and seemed only curious. Curiosity is evident in new kids confronted by strange goats. Kids show curiosity and playfulness when climbing about on their bedded mothers or when nuzzling their faces.

Minor solitary play patterns are bucking and butting. On occasion isolated kids butted their mothers hind legs in the same manner as mutual butting.

### 3.2.2 Associative Play

Associative play patterns develop following introduction of new kids into female-young groups. Four acts form the basis of the associative play repertoire, leaping, mutual butting, mounting, and occasionally the "king of the castle" pattern. Leaping often starts and is interspersed throughout bouts of mutual butting and mounting. Play mounting is often mixed with neck fighting. Butting is occasionally performed by only one kid which simply approaches a congener and butts it in the flank or ribs.

With time, play bouts increase in vigor and complexity. Duration of play bouts increases until July, then decreases (Table 9). Frequency of play bouts increases throughout June and decreases thereafter (Table 9). During the peak period of play any bout is variable as to context.



Associative play increases as kids are introduced into female-young groups. The frequency of solitary play increases also but to a lesser extent (Table 9). Late summer play patterns change; butting becomes altered in that kids no longer stand side by side in close apposition but attempt to avoid close bodily contact. Frequency of play bouts decreases until return of the female-young groups to the wintering area in October when concentrations of kids seem to be responsible for a slight increase in play (Table 9). Throughout the fall and winter play frequency remained low in all age classes.

### 3.2.3 Play In Different Age Classes

Associative play between animals of different age classes is rare. However, when it occurs it is generally between yearlings and kids. Yearlings and older goats rarely play but when they do, it is in the manner of solitary kids. The only play patterns observed among juveniles and adult goats are the leaping and head shaking acts. Under certain conditions nearly all members of a group of goats may become involved in play. Groups of goats will race down and across gravel or skree slopes, leaping upright on their hind legs and shaking their heads. Due to the unstable nature of the substrate the goats often slide downslope.

### 3.2.4 Play Initiation

Certain physical factors of the environment such as the presence of soft wet earth, loose gravel or skree slopes are seemingly correlated with play. Social circumstances



such as the presence of goats playing may also be correlated with play in other goats. Other conditions which seem to increase play are when goats are moving down to and are concentrated at mineral licks. Goats most often play on gravel banks above the mineral licks along the Banff-Windermere highway.

Playing kids seem on occasion to stimulate play in their elders. I have seen adult and juvenile goats stand and watch kids play, then begin playing themselves. I did not observe kids playing in muddy areas which are sometimes used by adults, but they do play on skree, gravel, and snowy slopes.

There are several situations which seem correlated with play in kids. Play frequently occurs after nursing bouts, during group movements and immediately after kids get up from their beds. Play is occasionally initiated by invitation; a kid wishing to play lowers and nods its head up and down as it approaches another kid. If the kid approached does not respond it is often butted in the flank or ribs. The lowered nodding head of the kid presenting the invitation resembles the mutual butting behavior of associative play. Play initiation is variable; bouts may arise when two kids approach each other with heads lowered and cocked to the side as if performing a present threat, or they may arise when kids approach each other leaping and spinning.



### 3.3 Discussion

#### 3.3.1 Solitary Play

I have observed kids playing within 8 hours of birth and at least 10 kids playing within 24 hours of birth. All kids are playing within a week of birth. Some of the earliest types of play may have unlearned aspects. The vertical leap and its derivatives, as well as bucking behavior, seemed to be unlearned. The butting behavior kids direct toward their mothers may be the forerunner of the mutual butting behavior of associative play since it precedes mutual butting by several days. The lateral upward butting movement may be an unlearned movement. Exactly the same movement is observed later in the butting play, the horn swipe, and later in fighting. Butting behavior is probably not learned as it was observed in kids which were in isolation with their dams and had never had the opportunity to see this behavior in other goats. The slashing movement used by the new kid forms the basis for much of the aggressive behavior of later life when the horns have grown.

#### 3.3.2 Associative Play

The play pattern "king of the castle" is commonly observed in young domestic sheep and goats (Hafez and Scott 1962). Several of the kid's play acts appear to be forerunners of other acts such as neck fighting which resembles mounting or chin resting in rutting males. There may be some connections between neck fighting in the kids and the chin resting behavior of courting male mountain



goats (See Section 4.1).

There seems to be a development of play patterns over the year. Complexity of play behavior seems to increase then regress with increased age of the participants. It is interesting that play in older goats resembles the initial play of new kids. I suggest that this regression of complexity is related to horn growth which would tend to explain the avoidance of bodily contact in goats older than approximately 3 months. The aggressiveness of mountain goats combined with horn development in the kids would tend to eliminate play forms which could cause injury.

Associative play forms appear to develop through association of kids of similar ages. Solitary play is relatively impoverished in terms of complexity of elements compared with associative play which exhibits an enriched repertoire.

### 3.3.3 Play Elicitation

Nursing and play seem related since play frequently follows nursing bouts. This relationship has been recognized in domestic lambs and calves. Well nourished lambs and calves spend a significantly greater amount of time playing than do lambs and calves on poor diets (Brownlee 1954, Hafez and Schein 1962).

### 3.3.4 Significance of Play

Much of the mountain goats play behavior had similar though not identical counterparts in "serious" behavior. Mutual butting and play invitations resemble fighting and



threat behavior, mounting and neck fighting have their counterparts in reproductive behavior. Leaping, spinning and head shaking movements however seem to lack counterparts in serious behavior.

Play behavior may be important to goats in a variety of ways. When playing kids exercise muscles and tendons, hence training these organs in coordination and tone for use in corresponding serious behavior (Brownlee 1954). Through play kids may become familiar with their environment and other members of their species. Familiarity with the environment is invaluable to any animal. Knowledge gained through play may be valuable in repelling or escaping from predators or congeners.

Egerton (1962) suggested that play may be important in developing the behavior of the young so that it comes to resemble that of the adults. She also suggested that play may be important in loosening the maternal-filial bond; this may hold in mountain goats. At first play occurs close to the dam but later at increasing distances. In early associative play bouts dams express anxiety for their kids by disrupting play and dispersing strange kids. Later the dams ignore the play of their kids. Play is probably important in social integration and in survival of the individual.

It is doubtful if play in the adults serves the same function as in kids. Adult play can be of little survival value as the goat has already been integrated into the



population. Brownlee (1954) suggested that there might be "emotion" involved in adult play. Adults may simply enjoy playing and the activity may be its own reward. An essential feature of play is that it appears to give satisfaction to the animal by mere repetition and can be indulged in by either a solitary animal or several animals together (Poole 1966).



#### 4. REPRODUCTIVE BEHAVIOR IN THE MOUNTAIN GOAT

I have used both definitions of "rut" from Heape (1900 in Fraser 1968): the rut "is both the season during which mating occurs" and "the male behavior during this period". Rutting behavior in the mountain goat is restricted to a relatively discrete period. My earliest observations of reproductive behavior were on November 3, 1967 and the latest during the second week of December 1967. During November rutting males mingle with other members of the population (Fig. 31), traveling extensively back and forth over the wintering area. Any female encountered is investigated and if receptive, the male will accompany her for one to several days.

The intensity of courtship behavior is not constant but changes throughout the rutting season. Courtship bouts vary from basic sexual investigation to complex patterns composed of the entire reproductive repertoire. A single courtship bout is herein defined as, "the approach and investigation of a female by a male".

4.1 The basic acts of the male reproductive repertoire are described below

##### a) Low Stretch

In the low stretch the knees are partially flexed, the head and neck are extended parallel to the ground and the ears are cocked forward (Fig. 37). The act is often performed in a hurried manner with a rushed final approach to the female (cf Geist 1965).

Fig. 37 Male performing the low stretch when approaching a female.





### b) Sexual Investigation

An investigating male approaches a female from behind and sniffs and vigorously licks below her tail (Fig. 38). On approach of males, females generally raise their tails. Receptive females frequently micturate.

### c) Lip Curl

After investigating a female's genitalia or urine the male raises his head above the horizontal, extends his head and neck, retracts his lips and wrinkles his nose (Fig. 39). Urine spots on the ground or urine directly from the female may be tested prior to performance of the lip curl (cf Geist 1965).

### d) Foreleg Kick

If the female is receptive (stands still and does not resist) a male delivers a stiffened foreleg blow between the females hind quarters (Fig. 40). Occasionally the foreleg movement appears to be a caress of the female's flank. The foreleg is raised and rubbed along the female's flank (Fig. 41).

### e) Tongue Flicker

A male courting a female flicks his tongue rapidly in and out of his partially opened mouth (Fig. 37). A few males may simply allow their tongues to loll out of the side of the mouth. The tongue flicker may be performed with all of the courtship acts with the possible exceptions of chin resting and copulation.

Fig. 38 Male sexually investigating a female.



Fig. 39 Male performing the lip curl.

Fig. 40 Male performing the normal foreleg kick on a female. Note, the male is performing a head lunge and tongue flicker in conjunction with foreleg kick.

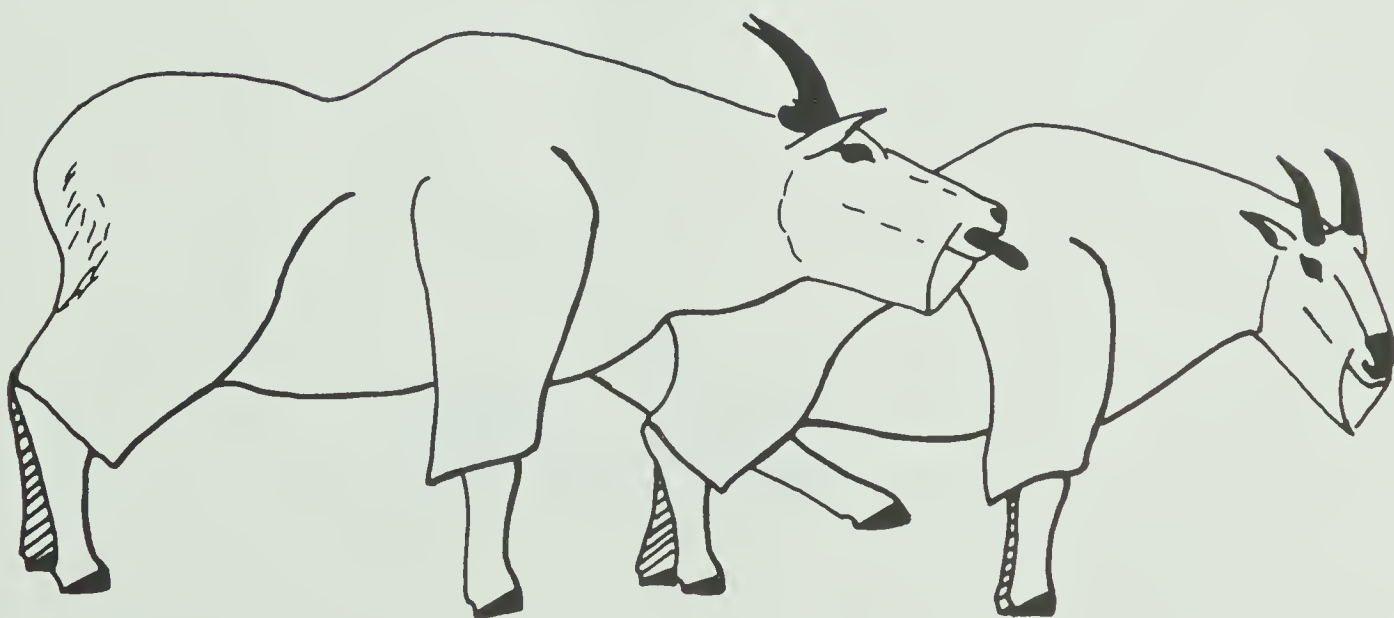


Fig. 41 Male caressing a female's flank in a variation of the foreleg kick.





#### f) Head Lunge

The male stands beside or at a slight angle to the female. Short darting movements of his head with the muzzle extended are directed towards the head and neck of the female (Fig. 40). The act is often performed from a crouched position. The male's beard seems to be prominently displayed, as he frequently turns his head at a slight angle and looks away from the female.

#### g) Pawing Recumbent Females

Males paw or prod bedded females with a forefoot in an effort to make them stand for investigation (Fig. 42). The male often performs the act from a crouched position beside the female.

#### h) Chin Resting

A male performing a chin rest places his extended head and neck across the back or rump of a female being courted (Fig. 43). The male may stand at a slight angle to the female facing anteriorly or posteriorly or directly behind her.

#### i) Mounting

When mounting a female the male rears up on his hind legs and clasps her about the flanks with both forelegs (Fig. 44). When the mount is performed from the lateral position the male throws a foreleg across the female's rump before clasping her.

#### j) Copulation

The copulatory position is essentially the same as the

Fig. 42 Courting male pawing a bedded female.

Fig. 43 A courting male performing the chin rest on  
a receptive female.

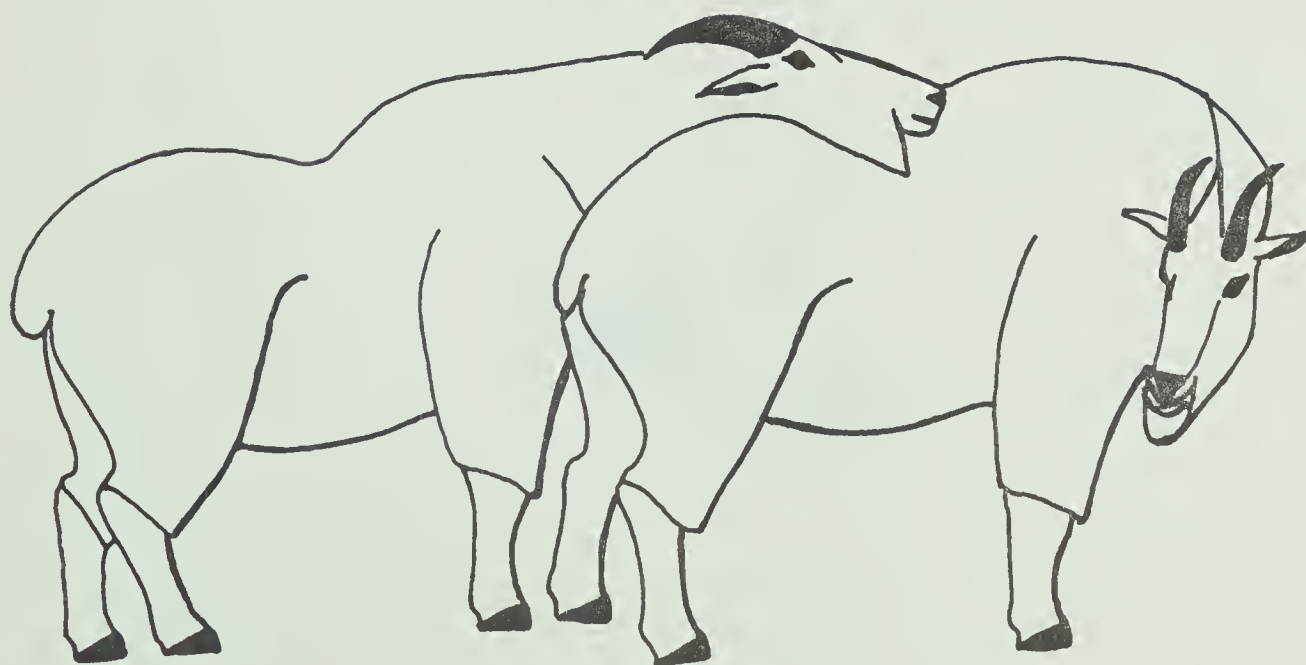


Fig. 44 Male and female in copulatory position (After Geist 1965).





mount; the male clasps the female about the flanks with his forelegs to maintain his position (Fig. 44). Several pelvic thrusts are performed culminating in a final lunge which I took to mean that ejaculation had occurred. Following this the male collapses over the back of the female where he rests until he slides off or the female moves out from under him (cf Geist 1965).

#### 4.2 Other male acts characteristic of the rutting season

##### a) Male Present Threat

In the male present threat, a displaying male arches his back, and holds his head low and beside his foreleg. The horns are pointed up and towards his opponent, the muzzle is turned away from his adversary (Fig. 45). Males in an intense threat display sidle towards each other in a head to hind end orientation which is the basic combat position (Fig. 46) (cf Geist 1965).

##### b) Pitting Behavior

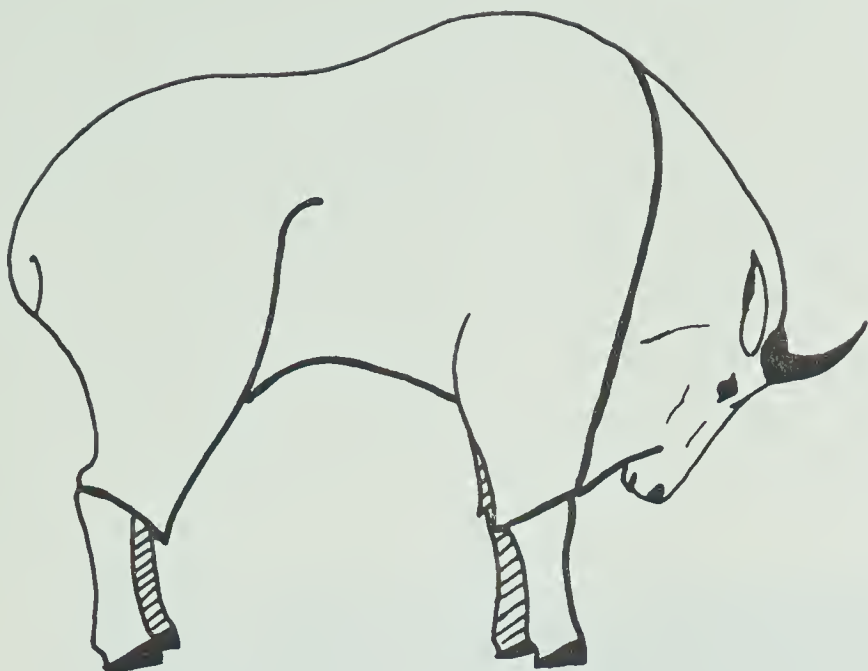
The rutting pit is a shallow depression dug by males during the rutting season. When preparing rutting pits males assume a sitting position with back and neck arched. Males sit on one flank while bracing themselves with the opposite foreleg and pawing with the other forefoot, raking back earth and snow over their belly and hind legs (Fig. 47). In preparing pits males soil their flanks and belly (cf Geist 1965).

##### c) Bush Rubbing

In this act a male lowers his head and sweeps his

Fig. 45 Male in the present threat position.

Fig. 46 Males in the basic combat position.






Fig. 47 Male preparing a rutting pit. Note, picture taken in late June, only observation interpreted as pitting behavior made during summer.





horns laterally and upwards through a clump of grass or low shrubs (Fig. 48) (cf Geist 1965).

#### 4.3 Courtship Behavior

The following description of courtship behavior is a composite of the most consistent acts observed throughout two rutting seasons. It should be emphasized that to find all of the acts in the sequence described below in a single courtship bout is exceptional.

##### 4.3.1 Pre-copulatory Behavior

A rutting male encountering a female during the rutting season approaches her in the low stretch simultaneously performing the tongue flicker. The initial approach is usually hesitant but the last part of the approach is often a short, hurried rush from directly behind the female, this leads to sexual investigation. Sexual investigation seems to stimulate the female to micturate if she had not already done so at the male's approach. The male noses the stream of urine or examines the ground urinated upon and performs the lip curl. The male returns to investigating the female. If the female is receptive the male performs the foreleg kick.

##### 4.3.2 Copulatory Behavior

Copulatory behavior normally begins with a foreleg kick and is followed by repeated mountings. Interspersed with mounting attempts the male performs the head lunge, tongue flicker, and chin caress. After several mountings with pelvic thrusts the male achieves intromission and ejaculates.

Fig. 48 Male rubbing his occipital glands along  
a branch of a shrub.





### 4.3.3 Post-copulatory Behavior

Following copulation the male is indifferent to the female for a brief interval. No displays or vocal signals following completion of copulation were evident. Prior to copulation again the male generally repeats the pre-copulatory behavior as described.

## 4.4 Analysis of Observations

With beginning of rut in mountain goats, male-male and female-male interactions increase in frequency (Figs. 30 and 32). Judging from their behavior males arriving on Mount Wardle are in or near rutting condition. The earliest rutting behavior which I observed already consisted of many of the components of male courtship behavior.

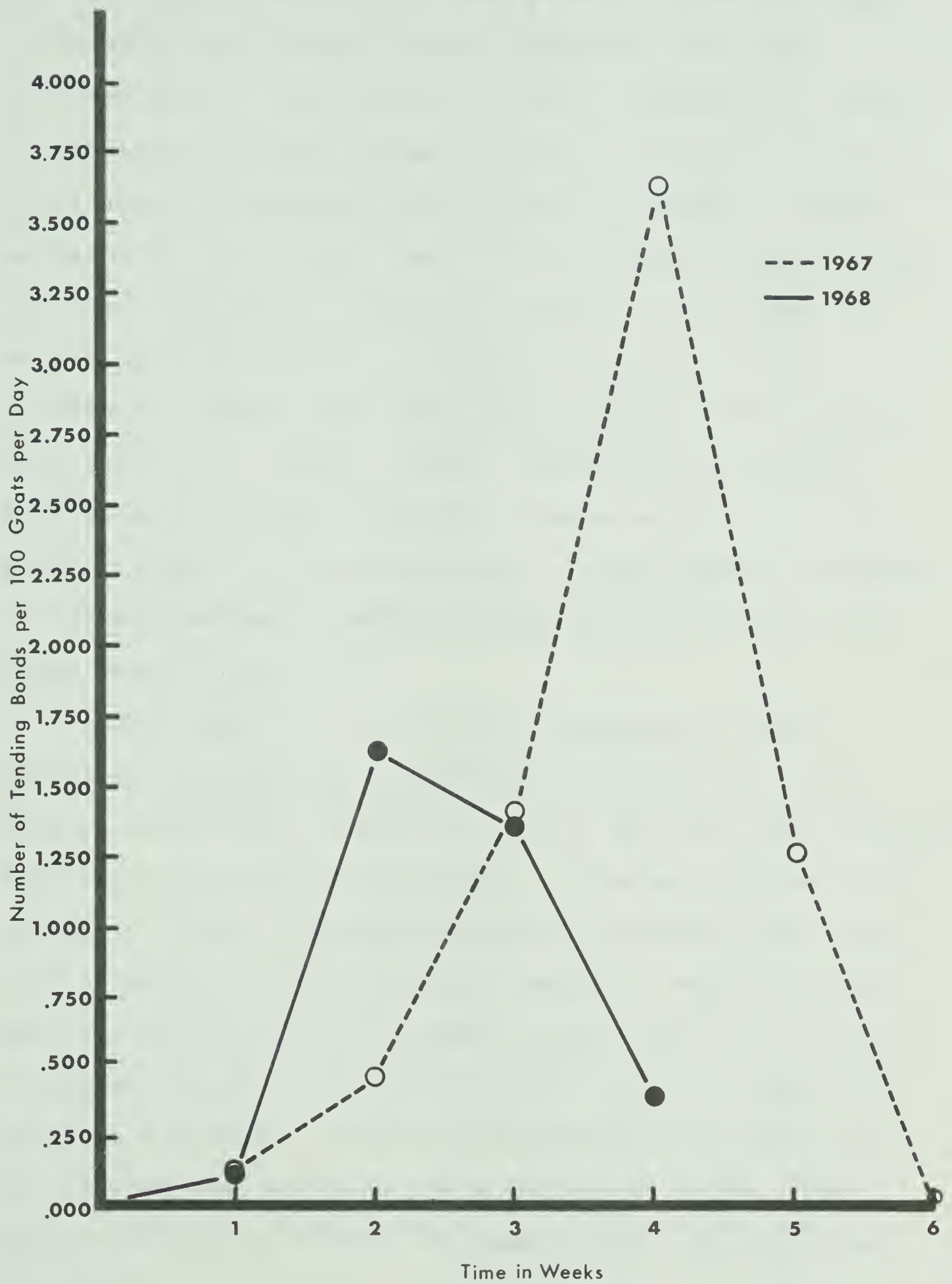
### 4.4.1 Tending Behavior

Tending pairs begin appearing during the second week of November (Fig. 49). Tending bond formation in the mountain goat is without marked ceremony. Stages in bond formation appear to be as follows: a) sexual investigation of the female, and b) testing of the genitalia and/or urine, with the performance of the lip curl. If a female is found to be receptive and tolerates a foreleg kick the male begins tending her, remaining close and periodically examining and courting her. "Tending pairs" are defined as males and females remaining in close association for several days during the rutting season. Throughout the association tending males feed little if at all. They simply stand above and guard their females.

Fig. 49 The occurrence of the tending pairs over the  
1967 and 1968 rutting seasons.

Time 0 = November 3, 1967

November 6, 1968





After bond formation tending pairs try to separate from the rest of the population; they generally move downslope to relatively low altitudes (below 6,000 feet) and seek secluded areas. Males move or control movements of females by herding using head lunges, foreleg kicks and occasional short jumps forward with both forefeet together. Female movement is restricted; they are not allowed to climb above the male. Pursuit of females by males did not appear to be part of courtship but an attempt to control their movements. Females are rarely threatened by males tending them and in turn females rarely threaten tending males. Females will threaten approaching males early in the rut before formation of tending bonds. Tending males repeatedly disrupted feeding or bedding periods of females to investigate them or court them.

Female resistance to courting decreases as male attentions increase in frequency, vigor and persistence. Females become more receptive to males and they stop fleeing and begin tolerating investigation, foreleg kicks and chin caresses. Table 10 presents some of the dynamics of male rutting behavior while attending females. Male courtship behavior during the rutting peak is performed in a frantic incomplete manner; I observed one male mount a female 24 times in 8 minutes. Females were assumed to be in or near estrus when they accepted the attention of males. When female resistance reached its lowest point copulation was effected.



Table 10 Dynamics of male courtship behavior in mountain goats of Kootenay National Park (Data from 1968).

	Courtship approach	Sexual examination	Lip curl	Courtship bout
Mean number of acts per male	4.5 n=153	7.6 n=34	1.4 n=34	7.6 n=257
Standard deviation	+3.9	+7.2	+ .8	+7.1
Mean length of act per male in seconds	19.2 n=153	163.7 n=260	30.8 n=49	175.8 n=257
Standard deviation	+22.1	+130	+13.6	+245.8
Frequency / male / hour	.037	.022	.007	.037

\*Based on observation of 34 males for a total of 206.5 hours throughout the 1968 rutting season.



The mean length of 16 tending bonds as represented by the period of isolation was  $2.38 \pm .7$  days. Duration of the tending bond may be a reflection of the length of receptivity of females with copulation occurring at the height of estrus. After 2 to 3 days males gradually lose interest in the females and move off. Copulation seems to occur in the first 2 days of the tending bond. Most females are receptive within a short period of approximately 2 weeks (Figs. 50 and 51). The periods of receptivity of individual females is approximately 2 days. Numbers of tending pairs reached a peak during the third week of rutting season in 1968 and the fourth week in 1967, thereafter numbers decreased rapidly.

Tending males generally react defensively when approached by other males. Intruding males are threatened and driven off as long as they are smaller than the tending male. At least five or 20 per cent of all tending pairs were disrupted through interference by other males. After disrupting a tending pair both the tending male and the disrupting males remain close to the female attempting to court her.

During the last week of November and the first week of December females are frequently harassed with repeated mounting attempts from groups of several males. In one instance a group of males pursued a female .5 miles while attempting to mount her. No single dominant male was identifiable in these groups. Within this context, a dominant animal is one which wins in any agonistic interaction, and a subordinate is an animal which loses in such an

Fig. 50 Frequency of copulation throughout two rutting seasons. Time 0 = November 3, 1967  
November 6, 1968

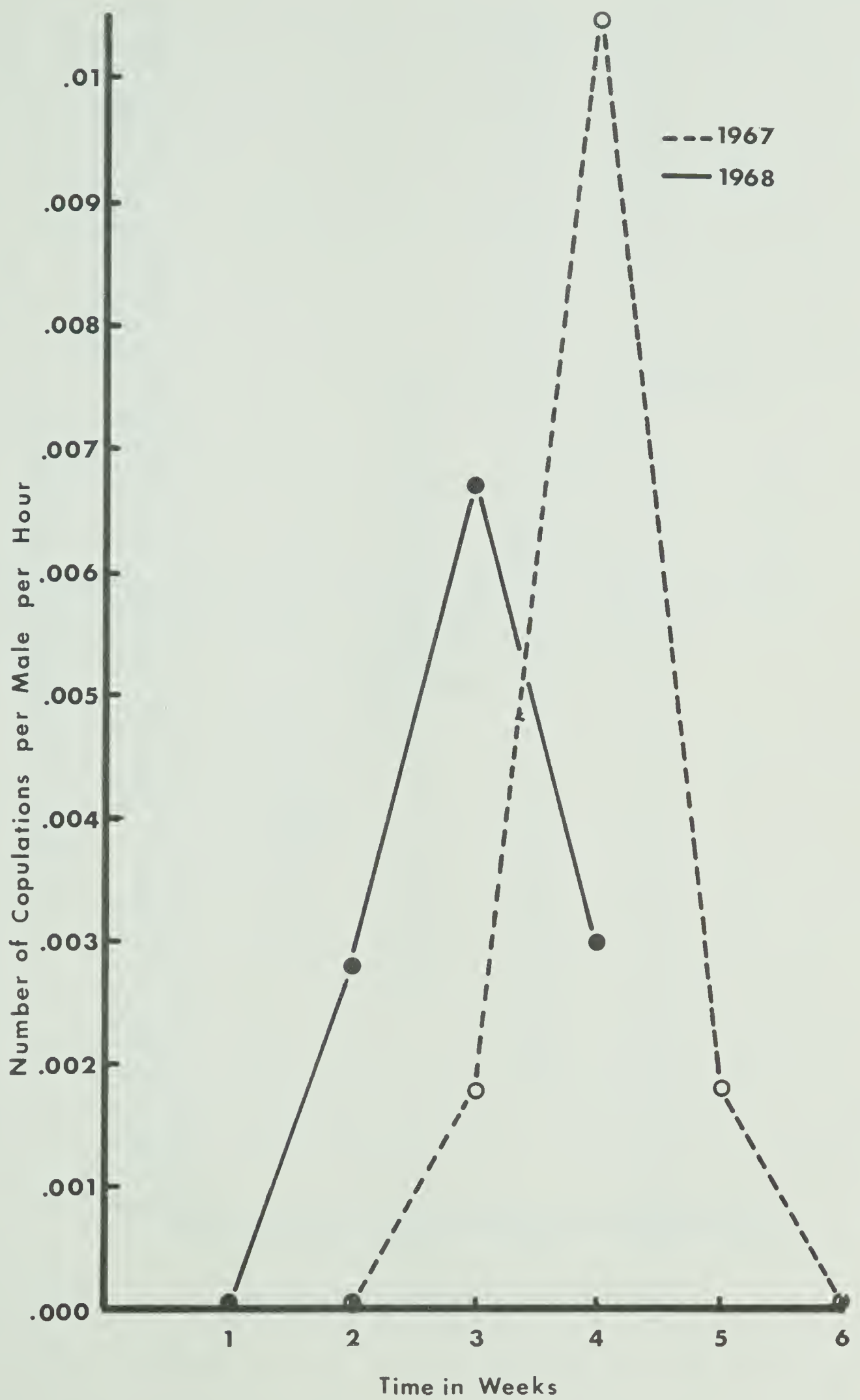
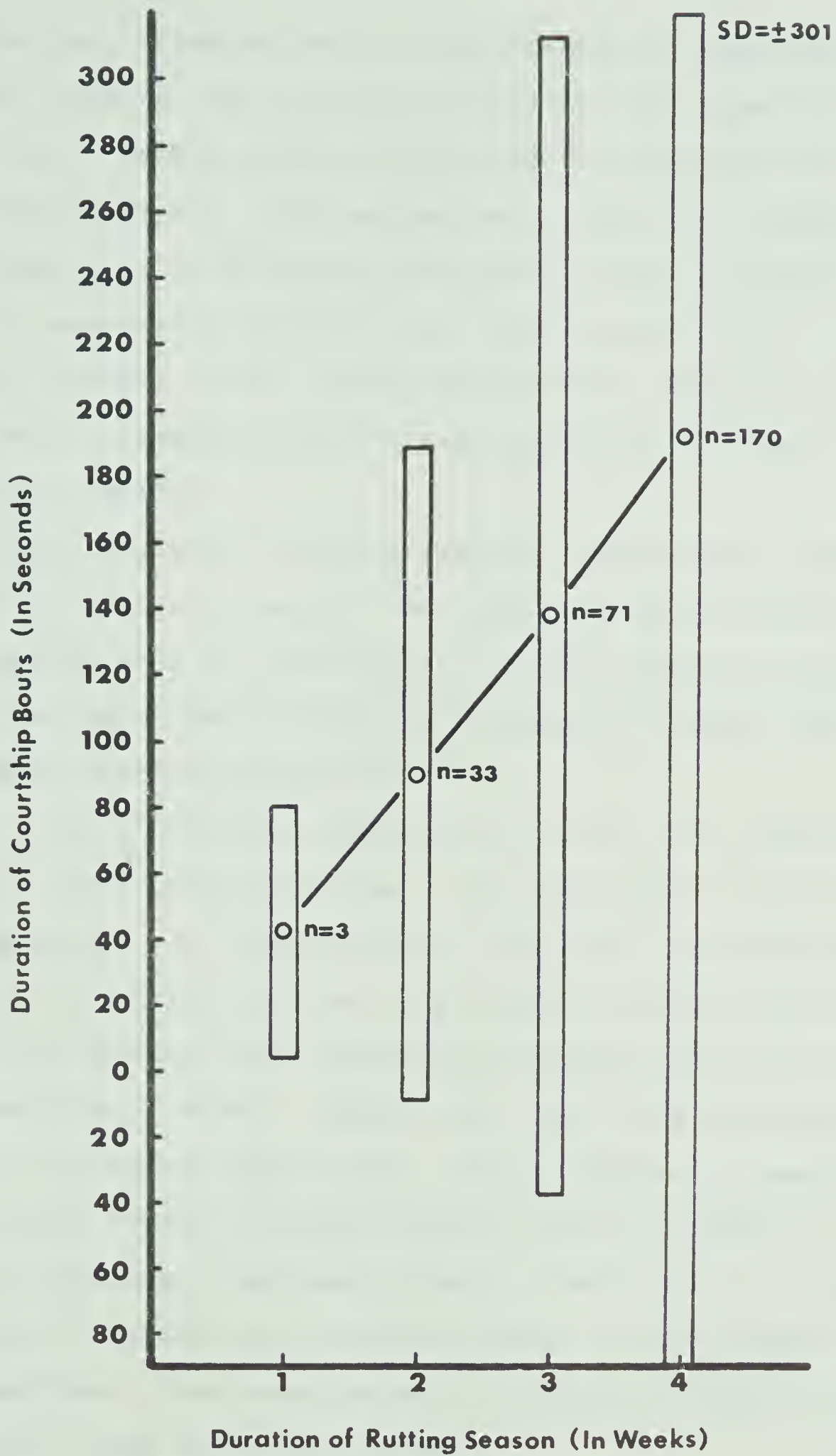


Fig. 51 Mean duration of courtship bouts during the 1968 rutting season. Note, observations halted on November 30, 1968.





interaction. Females react to harassment by remaining bedded, backing into a crack or pressing tight against a rock face. Females were not observed to encourage the pursuing males but rather attempted to ignore or escape from them. In 10 situations where male groups pursued a female, successful copulation was never observed.

At the end of the tending period males gradually lose interest in females and drift away searching for other receptive females.

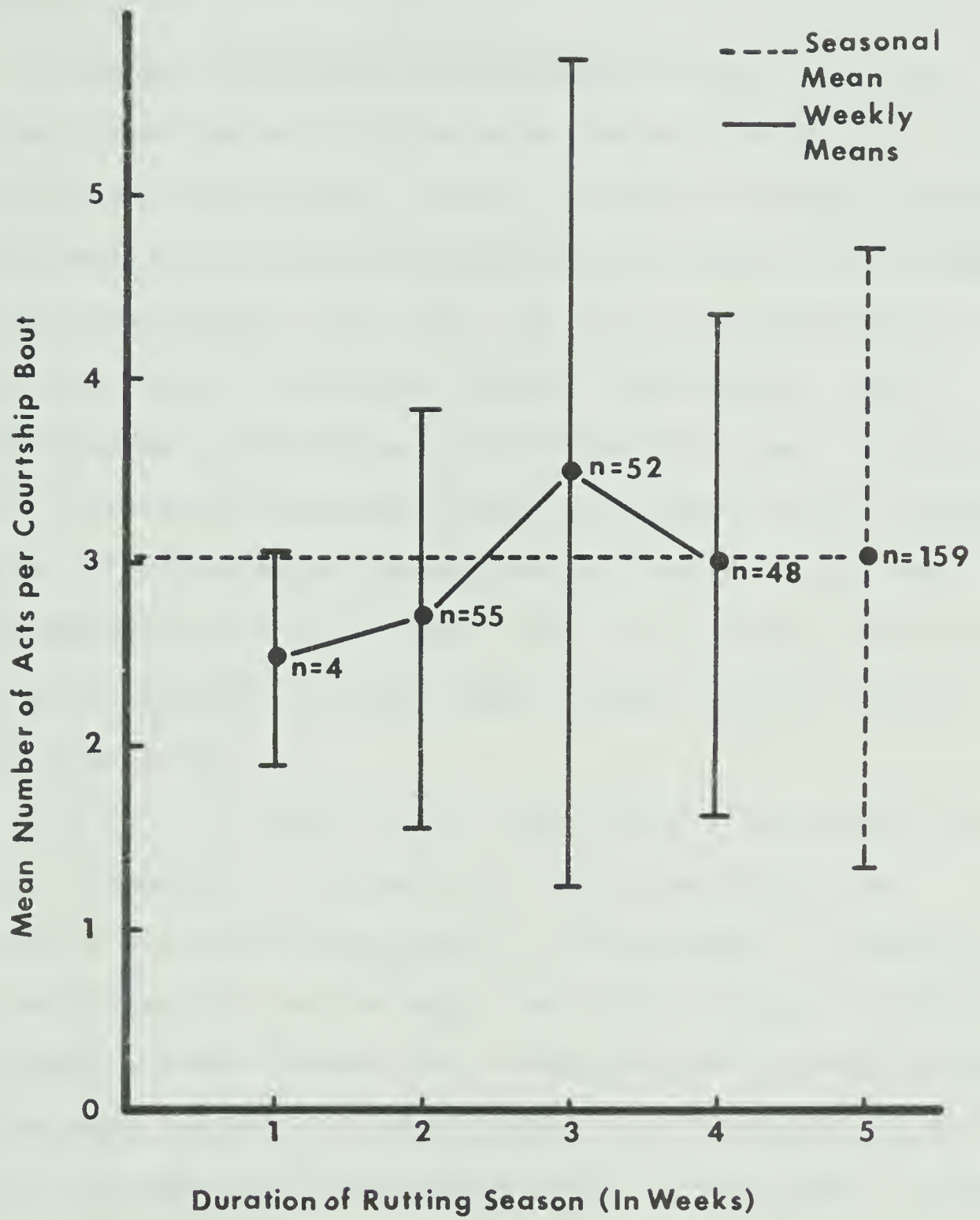
Males engaged in tending females nearly always ignored any kids that were present. Rutting males were observed to approach kids or yearlings in a sexual manner on three occasions; each time the male was a subadult (2-year-old).

#### 4.4.2 Courtship Dynamics

In early rut males spend much of their time searching for and investigating females. Courtships occurring early in the season are generally brief (Fig. 51) and relatively simple (Fig. 52); they rarely are pressed with any determination. Males are hesitant when approaching females and females are apprehensive of males. Females move away from courting males or threaten them briefly. When rebuffed by females males react in any of several ways; they may assume a conflict posture, stand and visually examine their surroundings or move off in search of another female. In the above circumstance I have observed males digging rutting pits and bedding in them for a short time.

Early courtships consist of an approach in which a

Fig. 52 Mean number of reproductive acts per courtship bout during the 1968 rutting season.





low stretch and a tongue flicker may be performed with the basic investigation of the female. Approximately 15 per cent of all courtship approaches are performed in the low stretch (Table 11).

Throughout the 1968 rutting season 49 per cent of females investigated by males were bedded (Table 11). As males become increasingly active in seeking out and investigating females they begin to approach and paw or nose bedded females persistently (Fig. 42), apparently attempting to force them to their feet for sexual examination. Many bedded females ignore males and refuse to arise. At such times I have observed males standing almost astride recumbent females. Excited males investigating females often move in exaggerated low stretches (Fig. 53). In intense courtship bouts males perform frequent head lunges, tongue flicker, and foreleg kicks.

#### 4.4.3.1 Variability and complexity of courtship bouts

All elements of the mountain goats reproductive repertoire are being performed by mid-November. Approach and investigation are the most consistent elements present in courtship bouts (Table 11). Frequency of courtship bouts and the mean number of elements per bout increases until the third or fourth week of November (Figs. 52 and 54). In the latter half of November courtship bouts are carried out with greater persistence, intensity, and complexity (Figs. 51 and 52). Performance frequency of the various acts suggests a pattern of increasing occurrence until the third



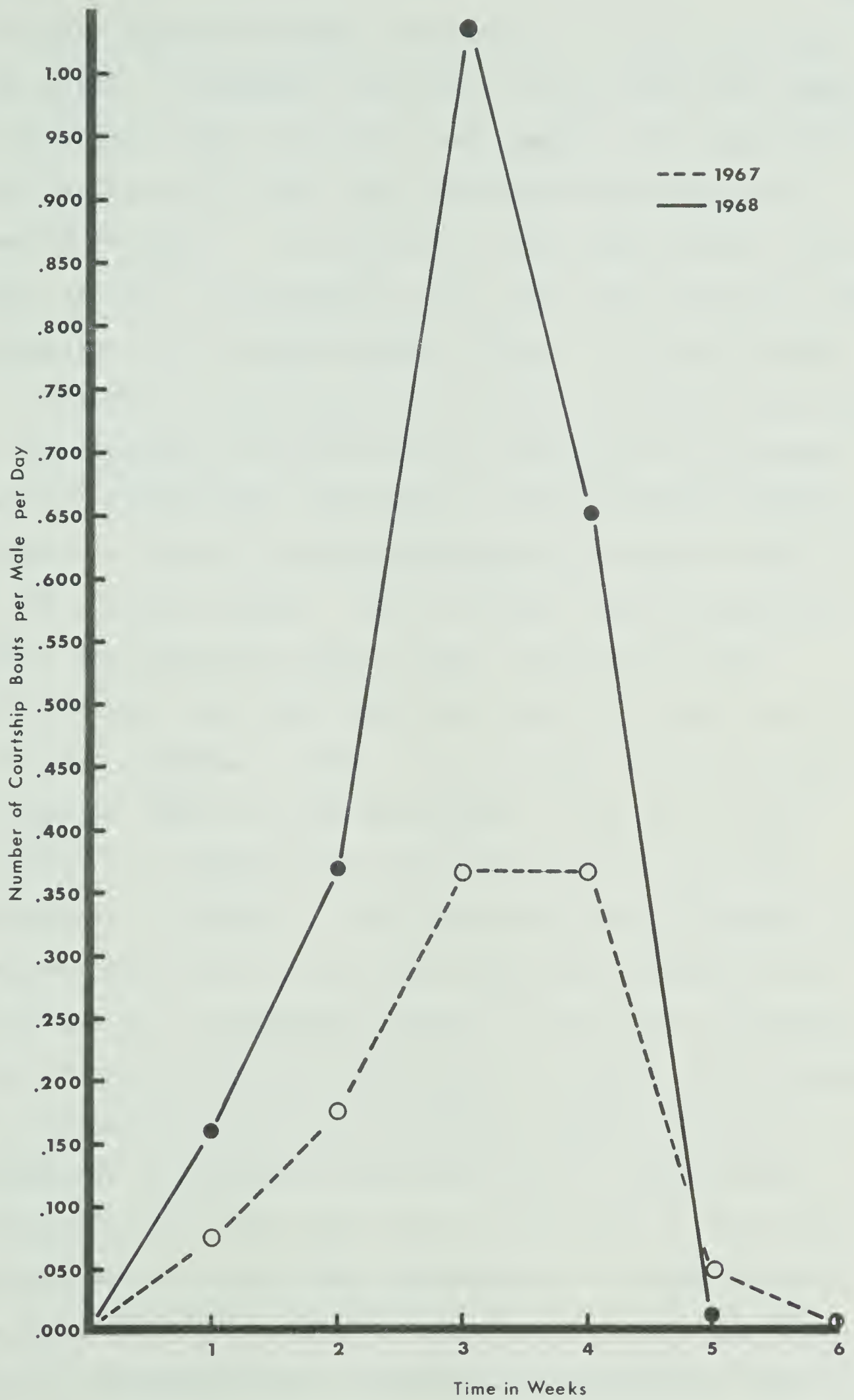
Table 11    Percentage frequency distribution of acts in 160  
              courtship bouts in mountain goats of Kootenay  
              National Park (Data from 1968).

	Percentage of total bouts
Courtship approaches	96.8
Courtship approaches to bedded females	49.4
Courtship approaches to active females	50.6
Courtship approaches performed in a crouch	14.9
Sexual examinations	95.0
Examination of bedded females	13.9
Examination of active females	86.9
Lip curl	12.0
Head lunge	13.2
Tongue flicker	20.1
Foreleg kick	18.2
Chin caress	8.8
Mounting	25.2
Copulation	6.3

Fig. 53 Excited male courting a female.



Fig. 54 Frequency of courtship bouts over two rutting  
seasons. Time 0 = November 3, 1967  
November 6, 1968





or fourth week of November, thereafter it declines (Figs. 50 and 54-56). Throughout the 1968 rutting season the number of courtship bouts increased continuously while the duration and complexity of these bouts decreased after the third week of November. As reproductive activity declines courtship bouts regress in complexity until they are little more than approaches and attempted mounts (Figs. 51, 52 and 54-56).

The occurrence of any but the most elemental acts such as the approach, investigation and mounting are extremely variable as are their positions in the courtship sequence. Figures in Table 11 show percentage occurrence of each act in 160 courtship bouts. Any act other than the approach, mount, and copulation which remain relatively fixed in position may occur more than once and in any position in a courtship sequence. Table 12 illustrates the variability in a selected number of courtship bouts. The acts in the sequence are numbered from the beginning with approach designated as number 1. The number of the act denoted its sequence position in a courtship bout, for example, the foreleg kick is designated numbers 4 and 7 this indicated that the act occurred as the 4th and 7th acts in the sequence for that particular bout. Courtship bouts leading to copulation are extremely variable but all retained one characteristic; copulation was not recorded as occurring between animals which were not members of a tending pair. The copulatory act could be relatively variable beginning with an attempted mount and ending in ejaculation (Table 13).

Fig. 55 Frequency of performance of the lip curl over  
two rutting seasons. Time 0 = November 3, 1967  
November 6, 1968

Fig. 56 Frequency of mounting attempts during two  
rutting seasons. Time 0 = November 3, 1967  
November 6, 1968

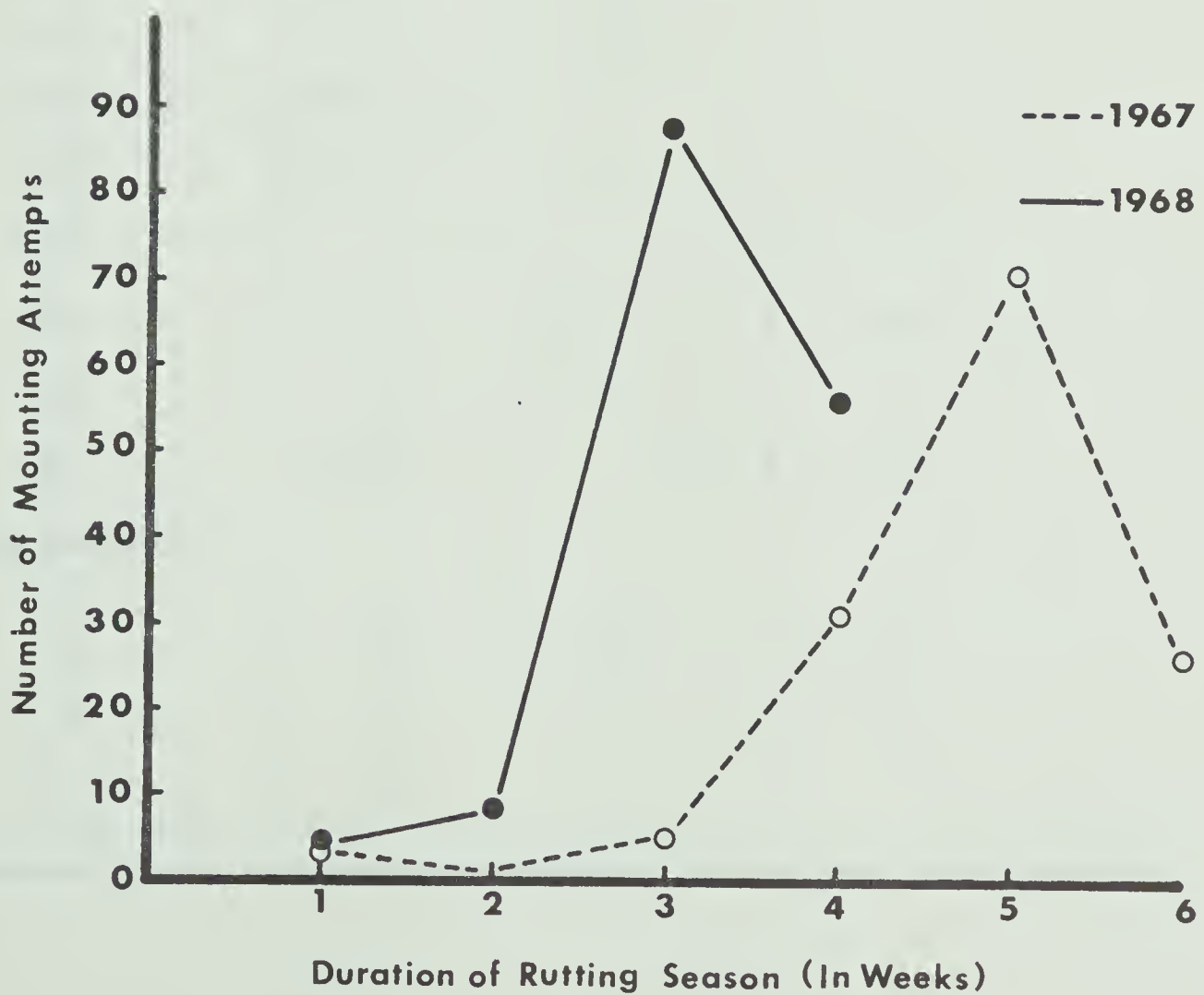
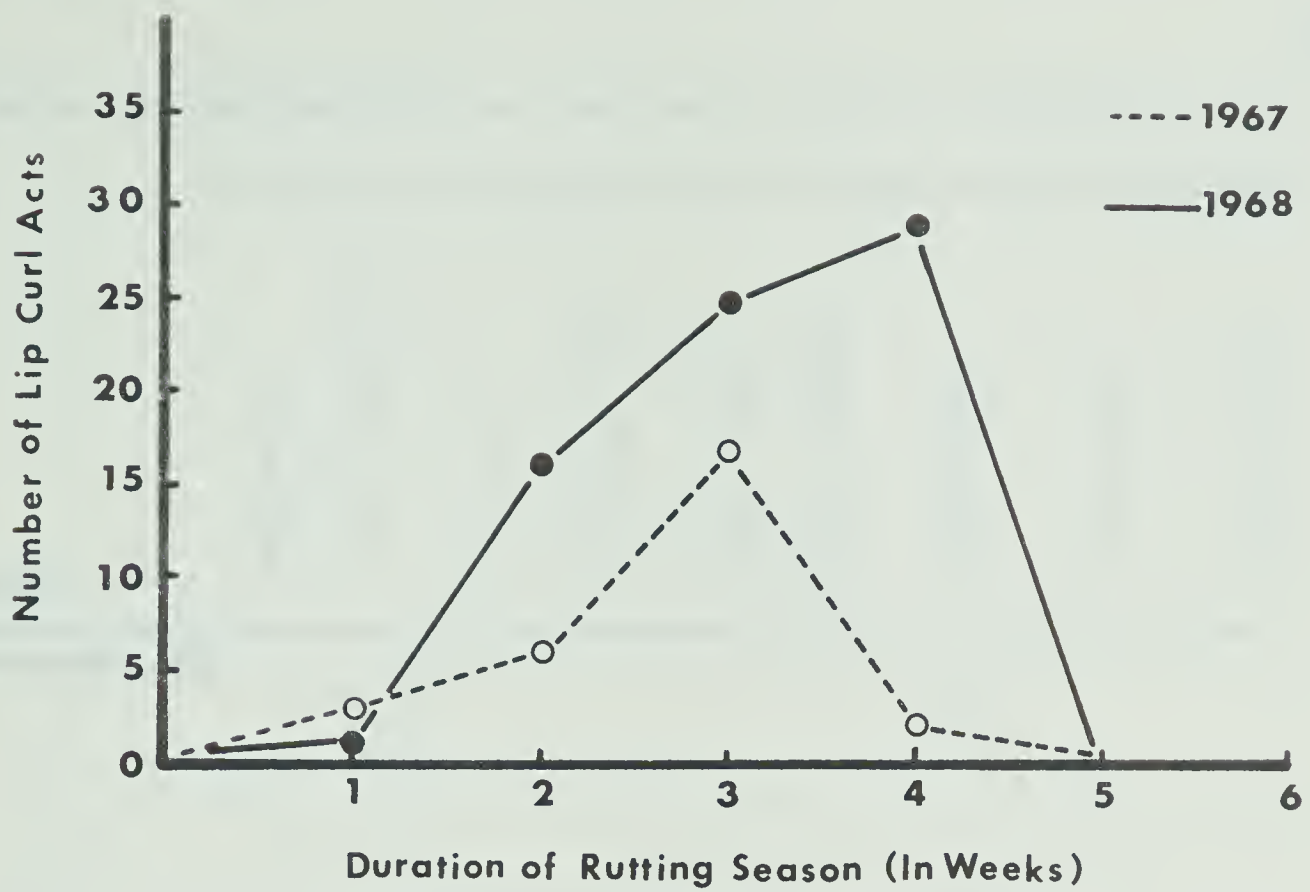




Table 12    Variability of courtship bouts in mountain goats  
                 of Kootenay National Park (Data from 1967-1968).

Dates	Approach	Investigation	Lip curl	Foreleg kick	Head lunge	Chin caress	Mounting	Thrusting	Ejaculation
November/67									
7	1	2,4					3,5		
11	1	2							
13	1	2							
13	1	3	4		2				
14	1	2,4		3					
15	1	2,4		3					
18	1	2,4	3,5						
18	1	2,5		3			4		
25	1					3	2		
27	1	2		3,6		4	5,7	5,6,7	7
28	1	2		3	5		4		
29	1	2,6			4	3	5,7		
December/67									
1	1						2		
3	1	2		6		4	3,5,7		
8	1	2		4	6	5	3,7		
13	1	2							



Table 12 (Continued)

Dates	Approach	Investigation	Lip curl	Foreleg kick	Head lunge	Chin caress	Mounting	Thrusting	Ejaculation
November/68									
7	1	3,5					2,4		
8	1	2		3					
9	1	2,4		3					
9	1	2	3		4				
12	1	2,4	3		5				
12	1	2,4	5	3					
15	1	2,5		3			4		
16	1			7,9	8	3	2,4	5	6
20	1	2	3				4		
21	1	2,4		3	5		6	7	
22	1	4		2		3	5		
24	1	2,4			3,5				
25	1						2		
27	1	3		2	4				
28	1	2		3					
30	1	2							



Table 13 Relationship between mounting, intromission and copulation in male mountain goats of Kootenay National Park (Data from 1968).

	Mounts	Thrusting	Copulation
Number of acts	292	58	35
Mean number of thrusts	-	4.72 <u>±.48</u>	8.14 <u>±.70</u>
Per cent of occurrence per mounting attempt	-	19.86	11.98



Changes in frequency of male reproductive acts may be indicators of the height of rut. The peak of rutting intensity was reached between the third and fourth weeks of November 1968 and the last week of November and the first week of December 1967. In November 1967 deep snow covered the wintering area; during the same period for 1968 snow cover was light. Rutting goats were concentrated into the relatively restricted areas of light snow cover in 1967 while in 1968 there was no restriction to movement.

Most elements of the reproductive repertoire occurred more frequently in 1968 than in 1967, although total time of observations was about equal (1967 = 221.5 hours and 1968 = 224 hours).

Male-male interactions appeared to be more intense in 1967 than in 1968. Acts such as the present threat were relatively more frequent in 1967 than in 1968. In 1967 with a wintering population of approximately 90 animals of which 17 were known to be adult males 45 present threats were recorded for a frequency of .29 present threats per day per male. In 1968 with a population of approximately 105 animals of which at least 22 were adult males there were 37 present threats recorded for a frequency of .19 present threats per day per male.

Throughout 1967 and 1968 only two subadult males were observed to maintain a tending bond only twice, both in 1968. Subadult males frequently approached and examined females. Subadult females (two-year-olds) were normally



approached and courted. Behavior of 2-year-old males indicated that at least some are sexually mature at that age. Subadult males approaching or courting females had reproductive behavior normal for adult males.

#### 4.4.3 Diurnal Distribution of Reproductive Behavior

The number of courtship bouts and concurrent reproductive acts per hour were recorded from approximately 0700 hours to 1730 hours or, light till dark for the 1967 and 1968 rutting seasons (Figs. 57 and 58). Two peaks of reproductive behavior occur in the interval 0700 hours to 1730 hours (Figs. 57 and 58) except in the case of copulation which shows only one slight peak of activity. Little reproductive activity occurs before 0900 hours and frequency of occurrence declines rapidly at 1700 hours. The data suggest that little if any reproductive activity occurs during the night. Mounting and courtship bouts both exhibited activity peaks at approximately 1300 hours and again at 1600 hours.

#### 4.4.4 Bush Rubbing and Pitting Behavior

The bush rubbing and pitting acts are performed by males nearly exclusively during the rut. The rate of their performance undergoes changes throughout the season (Figs. 59 and 60). Probable reasons for this are discussed later in this section.

Males that lead a solitary existence prior to the rut begin to exhibit increased aggressive behavior (Fig. 30), as well as increased bush rubbing and preparation of rutting pits. Bouts of bush rubbing and pitting are infrequent

Fig. 57 Diurnal distribution of observations of courtship bouts in the Mount Wardle mountain goat population (Data from 1967 and 1968).

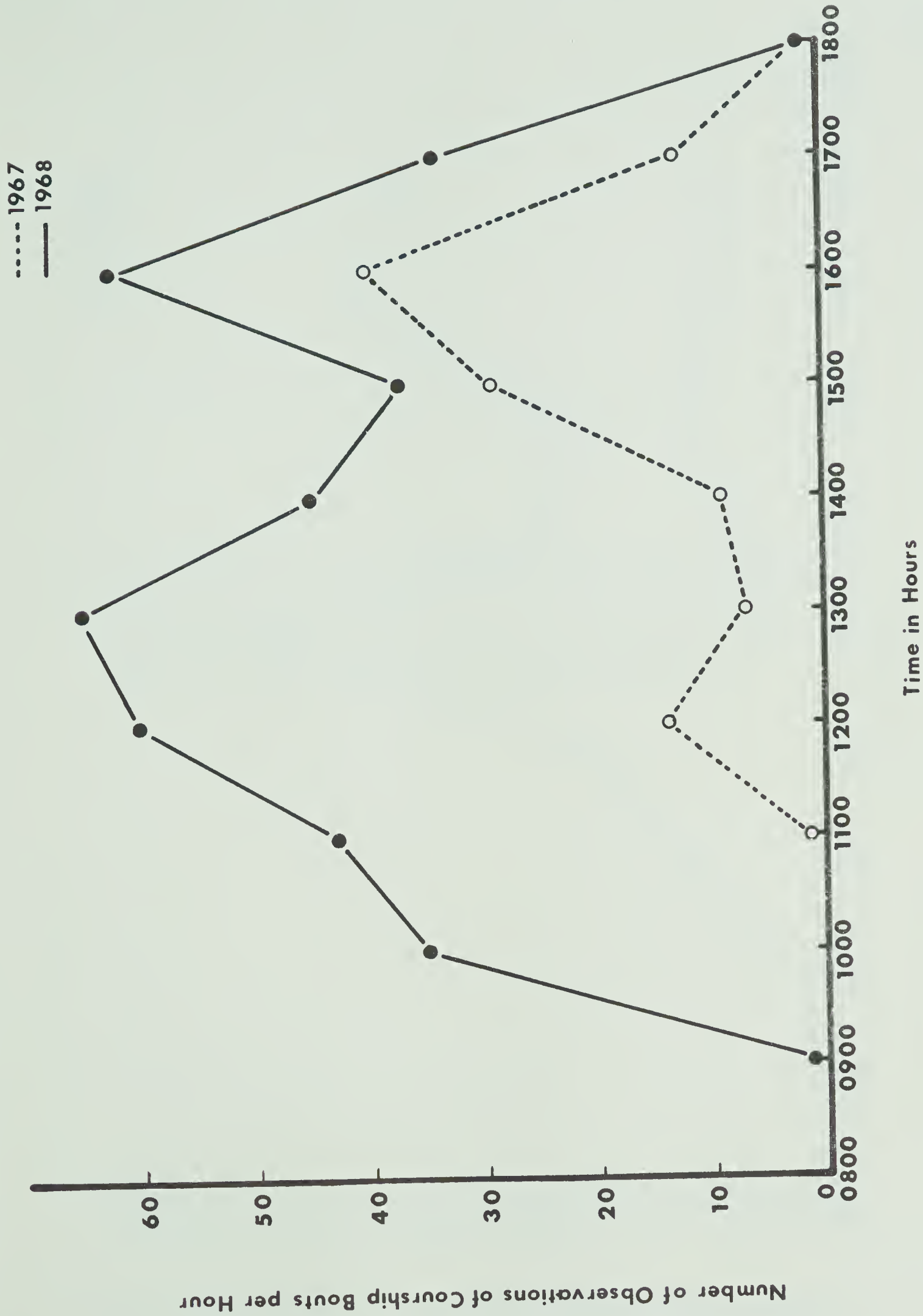


Fig. 58 Diurnal distribution of observations of mounting and copulation in the Mount Wardle population of mountain goats (Data from 1967 and 1968).

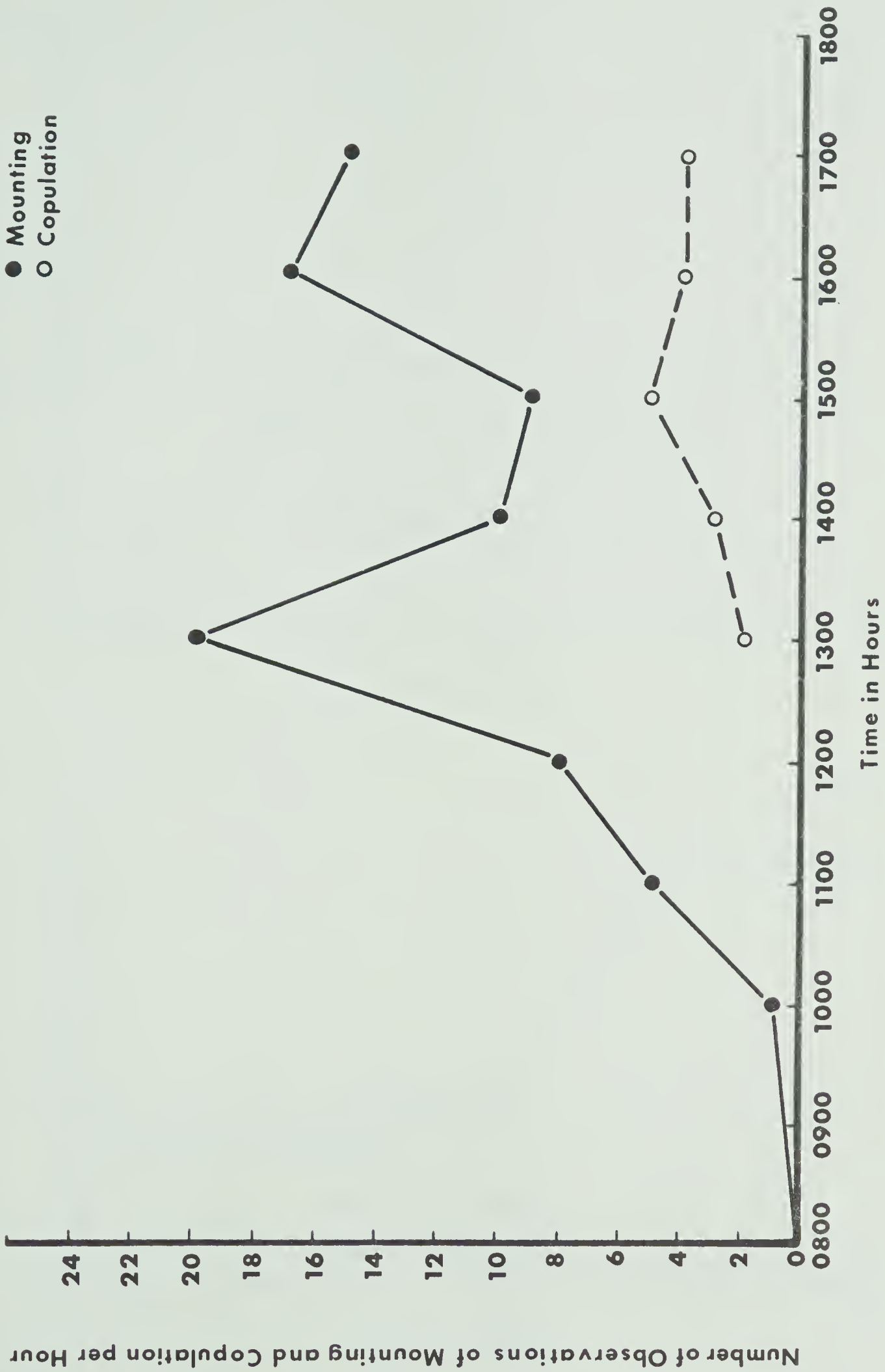


Fig. 59 Frequency of preparation of rutting pits  
throughout two rutting seasons.

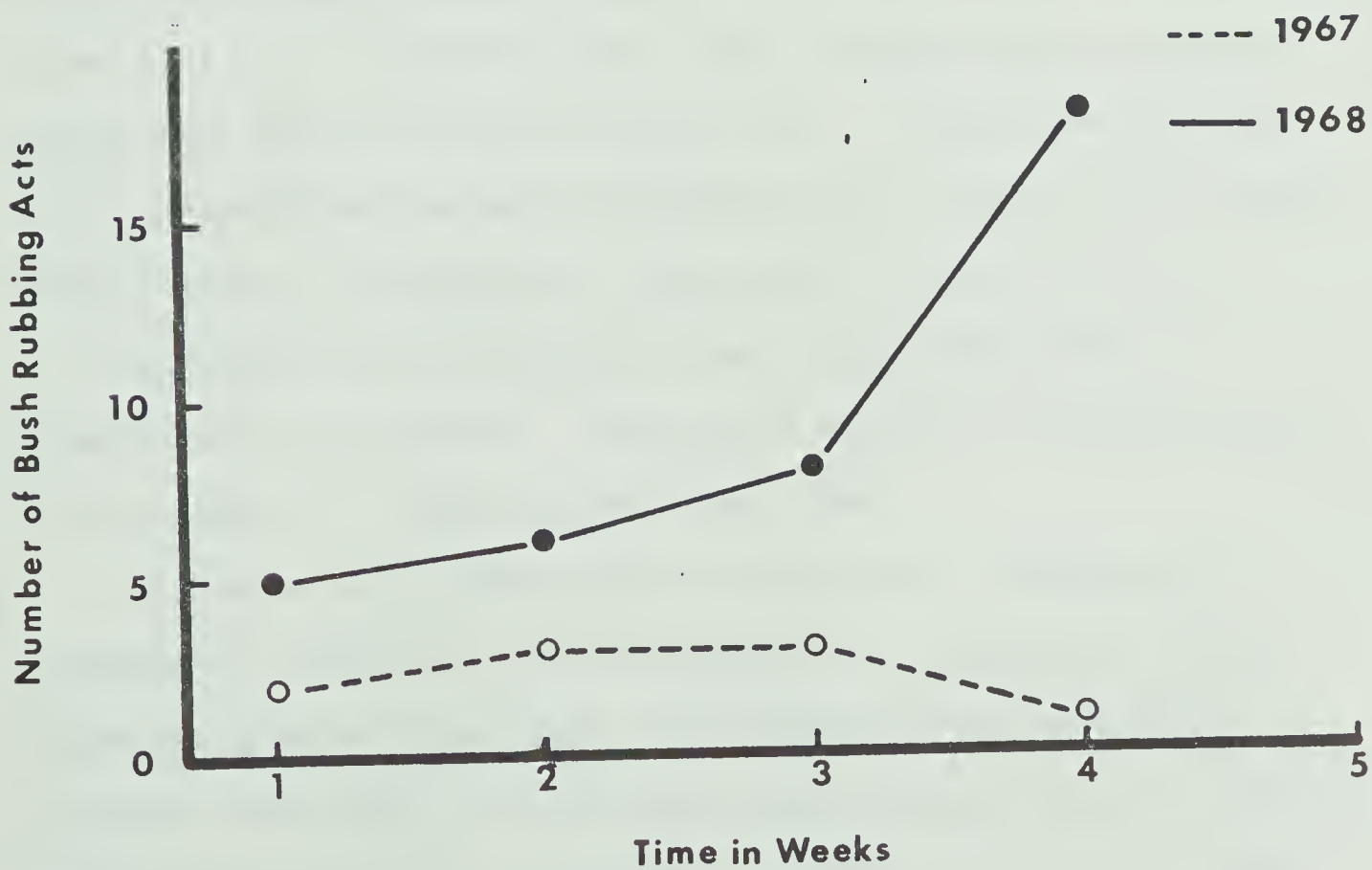
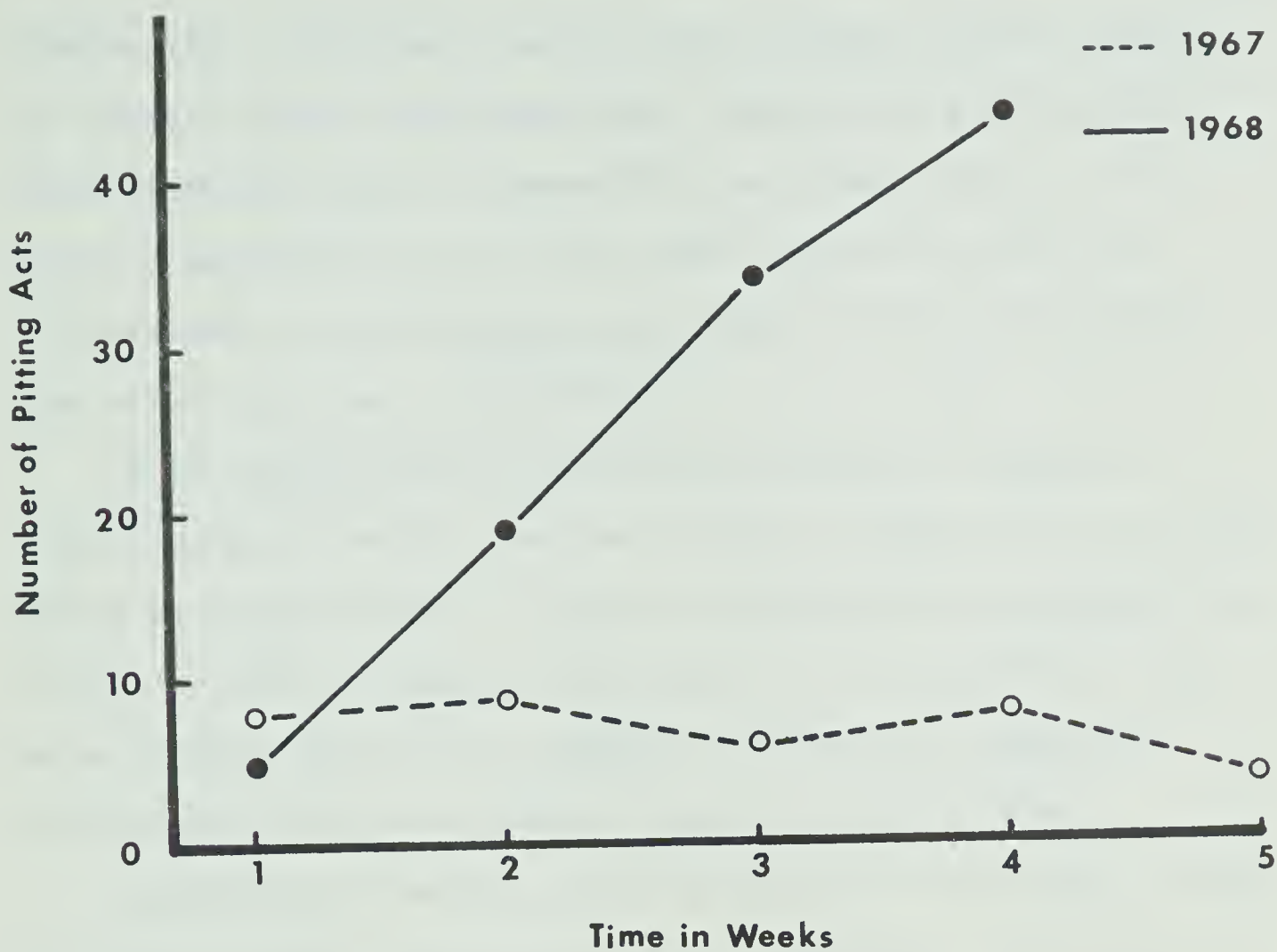
Time 0 = November 3, 1967

November 6, 1968

Fig. 60 Frequency of performance of the bush horning  
act throughout two reproductive seasons.

Time 0 = November 3, 1967

November 6, 1968





(Table 14). Each bout tends to be lengthy and be composed of several acts. Although bush rubbing and pitting have basic similarities in common with bush horning and dirt-bathing performed during the summer there are distinct differences in performance and circumstances surrounding the activity (See p. 27 and 30).

Bush rubbing and pitting occurred most frequently in sexual situations (83 per cent  $n=41$ ) or agonistic encounters (72.4 per cent  $n=134$ ). Sexual situations were accepted as those in which a female was present or involved with the male digging the pit or rubbing the bush and agonistic situations were interactions between rutting males.

Occasionally males dig rutting pits within male groups with and without concurrent threat behavior. Pits are of great interest to group members. Dominant males may displace subordinates from their pits, smell them, horn a nearby shrub and then proceed to dig or bed in the subordinate's pit. Travelling males on encountering a vacant pit nearly always pause to examine it and often to dig in it.

A number of rutting pits were examined after I displaced the occupant. None were muddy or had excessive urine odours or fresh feces about them.

Preparation, possession or both of a rutting pit frequently involves the performance of a present threat. Males displaced from their pits often stand and watch dominant males dig in and bed in the disputed pit. Subordinate males may move off or prepare a second pit close to their



Table 14    Bush rubbing and preparation of rutting pits in  
rutting male mountain goats of Kootenay National  
Park (Data from 1968).

	Preparation of rutting pits	Bush rubbing
Number of bouts	134	41
Mean number of acts per bout	1	2.03 +1.55 n=29
Mean length of bout in seconds	42.83 +49.89 n=83	48.0 +42.0 n=27
Mean length of act in seconds	—	16.61 +8.69 n=51
Frequency of act per male per day	2.534	.24
*Time spent performing the act per male in seconds	81.32	24.52

\*Based on observations of 34 males for 206.5 hours.



previous pit. Males approached while in their pits get to their feet and perform a present threat back and forth in front of their pit before an intruder.

Under certain circumstances the act of digging a pit seemed to have agonistic implications. I have observed males who having just performed a mutual present threat facing each other 30-50 feet apart start digging pits. I was able to induce a large captive male to perform a present threat and to dig a pit in my presence in September. The acts appeared to be in response to my approach, gestures and postures which were intended to imitate those of a threatening goat. The reactions of this male which I suggest was placed in a conflict situation seemed to indicate that pitting may be a reaction performed in an agonistic situation or a type of threat behavior.

During the non-reproductive season mountain goats appear distrustful of other goats in close proximity. The rutting urge to approach and investigate a female may place males under considerable stress. Each courtship bout may represent a conflict situation. Several rutting males in the same vicinity would increase such a stressful situation as I mentioned previously (See p. 67).

Rutting pits tend to be concentrated in areas with points of visual vantage. Individual pits may be used repeatedly by various males. Preferred pitting areas are much the same in substrate characteristics as preferred dirt-bathing areas. Rutting pits are variable in size



probably depending upon the amount of use they receive. Figure 61 illustrates a heavily used rutting pit in skree. The mean size of five pits measured  $48 \pm 7.5$  by  $42 \pm 8.1$  by  $8.8 \pm .2$  inches.

Bush rubbing is frequently performed near rutting pits, in conjunction with the pitting pattern. Bush rubbing is also performed during agonistic encounters throughout the rutting season when males are accompanying females. If pitting and bush rubbing are reactions to conflict situations the increased frequency as the rut advances (Figs. 59 and 60) is in keeping with increase in frequency of courtship bouts (Fig. 54) since the circumstances of courtship and agonistic behavior would tend to provide situations likely to result in conflict situations.

#### 4.4.5 Male-male Interactions During the Rut

As the reproductive season progresses and competition for estrous females becomes keener, the frequency and seriousness of agonistic encounters between rutting males increases. The present threat is the most important and typical threat display performed among rutting males.

During the rut there are two basic situations which result in present threats; potential threat to possession of a female or possession of a rutting pit. Occasionally chance encounters of rutting males result in threat displays. Present threats are most intense when two males of like size are involved.

Many factors seem capable of influencing the outcome

Fig. 61 A heavily used pit in a skree area.





of present threat bouts. Factors which seemed to be important in determining the victor in present threats were: size of the contestants, male initiating the threat and relative physical positions of the contestants. Duration of bouts was variable, the mean length of 14 bouts was  $37.5 \pm 32.6$  seconds.

The present threat is doubly important in male agonistic behavior since it is from this basic position that fighting starts. In 17 months afield I witnessed only one fight and that was between 21 month-old juveniles. Serious injury resulted to one juvenile in this fight as it was horned repeatedly in the flanks and abdomen. In November 1967 four wounded males and one wounded female were observed. Three of the males were injured in the flank and abdomen, the female was slashed down the back. No evidence of fighting was observed in November 1968.

The method of fighting and the weapons possessed by the mountain goat combine to make serious injury a near certainty in combat. Fighting goats assume an anti-parallel position close together (Fig. 46). The contestants revolve around each other slashing upwards with their horns into each others flanks and abdomen.

The rush threat is the second most often observed threat used by males during the rut especially when courtship patterns become attenuated (Fig. 52). and few females appear to be left in or near estrus. Any female near estrus is jealously guarded by several males; this gives rise to



constant interference to individual attempts at examination and copulation. Males were observed rushing at top speed across 150 yards of skree to threaten a copulating pair whereas the normal rush threat is short, 20 feet or less. In all instances observed, males threatened with a rush threat escaped injury. When an aggressor succeeds in displacing a tending male he takes over the attendance of the female until he in his turn is displaced.

#### 4.5 Discussion

##### 4.5.1 Tending Behavior

Duration of the tending bond in mountain goats may be a reflection of the length of the period of attraction of the female to the males. The length of the tending bond may in fact reflect the length of the estrus in the female. Severinghaus (1955) found that although estrus in doe white-tail deer averages 24-36 hours she is able to attract the buck for approximately 5 days.

I believe that many tending pairs are disrupted by rival males. This hypothesis is supported by several facts, the main one being movement into isolation of the tending pair. A movement into isolation would reduce the possibility of encountering other males which might disrupt a tending bond. After a tending pair is disrupted the female is frequently harassed by a group of males. Harassment or tending by a group of males is comparable to the situation in ram groups following ewe bighorns in estrus (Geist 1966). Ram groups always contained a dominant animal



which serviced the ewe but no such male seemed to occur within groups of male goats. Successful copulation in male groups is rare due to excessive interference by other males. Geist (1966) describes evasive actions in ewe sheep similar to those I saw in female goats. Blood (1963) reported long chases by several bighorn rams during the rut. In mountain sheep and black-tailed deer long chases seem preparatory to copulation (Geist 1966, Dasmann and Taber 1956). Female goats did not seem to solicit chasing as do black-tail does (Dasmann and Taber 1956). Such chasing or harassment of female goats may also occur but to a limited extent and only within tending pairs.

#### 4.5.2 The Low Stretch

The low stretch performed by the male mountain goat resembles a conflict posture. Situations in which the low stretch and conflict posture are performed are much the same, both in stressful conditions. The low stretch may be performed in response to an ambivalent situation, the urge to approach and investigate a female, and the reluctance to approach a potentially dangerous adversary.

#### 4.5.3 Sexual Maturity of Mountain Goats

Lentfer (1955) concluded on the basis of histological examinations of ovaries and testes that goats are not likely to become sexually mature until their third rutting season. Kerr (1965) cited observations on captive goats taken as kids which did not breed until their third winter. The females produced kids when they were 3-years-old. I recorded one



case where a 3-year-old female bore a kid. Geist (1966) suggested that performance of the lip curl by males indicated sexual maturity. Two-year-old males frequently performed the lip curl, perhaps indicating that they were sexually mature. I consider many male mountain goats of the Vermilion Range to be sexually mature at 2 years and adults at 3 years as defined by size and behavioral difference. There is a discernable difference in size between 2-year-olds and adult males. Females appear to be sexually mature at 2 years.

#### 4.5.4 The Effect of Snow on Reproductive Behavior

Snow and weather conditions during the two rutting seasons may have been responsible for variations in intensity and duration of the two seasons. The high concentration of goats in 1967 as a result of deep snow appeared to result in more interference and disruption of courtships and tending pairs than in 1968. Scant snow cover of 1968 allowed goats to disperse freely over wintering areas thus reducing incidence of interference of courtship. Geist (1965) has previously reported the effects of snow on reproductive behavior in the mountain goat, his observations coincided closely with mine. I suggest that the concentration of goats and resultant interference of 1967 reduced the frequency of courtship and prolonged the rut. Reduced interference in 1968 allowed at least two 2-year-old males to successfully maintain a tending bond and copulate with adult females. The behavior of older males seems to prevent 2-year-old males from taking part in breeding activity.



#### 4.5.5 Diurnal Distribution of Reproductive Activity

Data presented in Figures 57 and 58 are comparable with the findings of other workers. Several authors report that incidence of mounting in domestic sheep is correlated with the time of commencement of estrus in the ewes (Hutchinson, O'Connor, and Robertson 1964). Robertson and Rakha (1965) found that cheviot rams actively investigated ewes throughout the day. Heights of copulation in cheviot sheep correspond to the peak of estrus in the ewes.

Assuming that time and frequency of copulation reflect the peak of estrus in the mountain goat the data suggest that estrus commences at approximately 1600 hours (Fig. 58) and is thus similar to the sunset estrus of the domestic sheep.

#### 4.5.6 Significance of Rutting Pits and Bush Rubbing

It is difficult to visualize bush rubbing and pit digging as integrated elements of the male courtship repertoire, although the acts are restricted to the reproductive season and are performed only by rutting males. Observations suggest that pit digging and bush rubbing occur as marking behavior and reactions to stress situations. Conflict situations vary in form, particularly with a mutually dangerous yet gregarious species. The possibility of conflict situations compounds itself when such a species has a restricted rutting season.

Bush rubbing and use of rutting pits is common throughout the ungulate group. Geist (1965) considered bush rubbing



performed during agonistic situations by mountain goat males to be a marking pattern. My data support this statement on several points. If bush rubbing in rutting males is a marking pattern one would expect the act to be performed deliberately and with olfactory examination of the marking site. This is indeed the case with the mountain goat. Olfactory examination of rubbed objects by 77.4 per cent of males performing the act indirectly indicates deposition of odoriferous substances.

Bush rubbing patterns of mountain goats in conflict situations may correspond to the marking patterns of the chamois and the grass horning of the bighorn sheep (Couturier 1938 in Brandborg 1955, Geist 1966). If the mountain goat's bush rubbing pattern is for marking I assume that the occipital glands supply the secretion. The two occipital glands show a seasonal variation in size and begin to secrete "a strong odoriferous substance" during the rutting season (Brandborg 1955). The gland shows a seasonal enlargement in both sexes but is apparently active only in the male (Brandborg 1955, Anderson 1940, Seton 1927).

No discernable evidence for stationary territories could be found in the behavior of the mountain goat. Performance of a present threat around a rutting pit may be defence of an area but it is more probable that it is a reaction to the approach of a potential adversary. I could find no regularly used marking or rubbing sites. The one consistent factor in bush rubbing is the shrub type (Shrubby cinquefoil)



which is used nearly to the exclusion of grasses or other shrubs probably because it is so common on Mount Wardle. Horned shrubs were ignored by most goats, but were occasionally investigated by other males when the shrubs stood close to rutting pits.

Male behavior suggests that pit digging serves in some capacity as a marking device. How the marking procedure is carried out is uncertain. Perhaps body odour lingering in the pit serves as a scent marker. It is also possible that pitting serves as a visual marking device in one of two ways: a) the presence of a pit may advertise the presence of a male in reproductive condition, b) the soiling of the flanks, belly and abdomen of a male may advertise his reproductive state. Pocock (1910) reported what he believed to be interdigital glands in the forefeet of the mountain goat. If these are glands and they are active during the rut they could serve for marking.

Couturier (1938 in Brandborg 1955), Anderson (1940) and Seton (1927) all considered marking by chamois and bush rubbing by mountain goats to be aids for the two sexes to locate each other. They also suggested that marking might be effective in exciting the female preparatory to mating. I consider it more probable that in the mountain goat marking functions as an advertisement of a male to other males that a sexually active male is in the vicinity. It is improbable that bush rubbing serves to stimulate females or prepare them for mating since females were never observed examining



shrubs or grass clumps which had just been rubbed. In fact they appeared to ignore the rubbing act conducted in their presence.

#### 4.5.7 Significance of the Present Threat

The present threat appears to be a display of size. The stilted posture and movements emphasize the broadside outline of the threatening goat. The dorsal crest of long guard hair may serve to accentuate the illusion of increased body size. The present threat appears throughout the animal kingdom. Several of the bovids such as chamois and bighorn sheep possess a present threat, although they are very different from that of the mountain goat (Walther 1958, Geist 1966). Geist (1967) found that horn size and body size are extremely influential in determining the outcome of agonistic encounters in bighorn sheep. In encounters between male goats of similar size, males standing upslope appear to have an advantage, possibly he appears larger to his opponent. Aggressiveness or willingness to fight on the part of either male often was a factor in the outcome of threat contests.

The present threat is significant in male mountain goats since it serves as a threat and as the basic combat position. Geist (1967) described injuries incurred by a young male mountain goat which was inadvertently captured with an old female in Banff National Park. Most of the male's wounds were in the flank and abdominal areas and many penetrated vital organs. Most wounded animals observed in this study were injured in the flanks and abdomen as were



those examined by Geist (1965), in an earlier study. Combat appears to occur only between males of similar size. It is possible that there is more fighting than I observed. Loose skin and heavy pelage tend to close off all but the most serious wounds thus obscuring evidence of injuries. With specialization of the previously cited type of fighting the species has evolved a dermal shield up to 22 mm thick over much of the strike zone of the horns (Geist 1967). Geist (1965 and 1968) found fighting in mountain goats and bighorn sheep occurred primarily between animals of the same size class.



## 5. MATERNAL BEHAVIOR IN THE MOUNTAIN GOAT

To date little information is available on mother-young relations in the mountain goat. What is available is superficial, controversial and for the most part anecdotal.

### 5.1 Analysis of Observations

#### 5.1.1 Kidding Areas

It was evident after two kidding seasons that births of goat kids were concentrated in specific areas. Pregnant females select rough terrain for isolation during parturition. The most favored terrain of broken timbered ledges exists on the eastern half of Mount Wardle (Fig. 3) and approximately 75 per cent of 42 births occurred there. Kids were born at altitudes ranging from 4,800 feet in 1967 to 7,700 feet in 1968. Generally kids were born at lower elevations in 1967 than in 1968. Much of Mount Wardle was covered in deep snow to about 5,800 feet during the kidding season of 1967 whereas in 1968 snow cover was light and continuous snow cover did not extend below 7,800 feet.

#### 5.1.2 Kidding Season

The first new kids of 1967 were sighted on May 21 and the last on May 31; in 1968 the first new kid was recorded on May 24 and the last on June 3. In Table 15 I have assembled birth dates and time of earliest discovery. Only very young kids, those incapable of standing or extremely unstable upon their feet, have been included. Births recorded in Table 15 represent approximately 50 per cent of all



Table 15 Distribution of births in time of mountain  
goat kids in Kootenay National Park.

Date			Time of discovery
1967	May	21	18:45
		24	17:25
		25	15:20
		28	12:20 18:18
		31	18:32 18:52
1968	May	24	14:50 18:00
		26	16:35
		28	17:30 17:35
		29	09:50
		30	11:15 18:30
		31	16:00 18:30 18:45 20:00
	June	2	17:15
		3	19:20



births known to have occurred on Mount Wardle during the 1967 and 1968 kidding seasons. The end of May appears to be the peak of the kidding season (Table 15) with births distributed over about 10 days. Births also tended to occur in the afternoon.

#### 5.1.3 Gestation Period

It is assumed that the peak of copulation reflects the peak of estrus in females. From Figure 50 it is evident that the peak of the 1967 rut occurred on approximately December 1. It is also assumed that the period of most births represents the peak of the kidding season. An estimate of the length of gestation is provided by the time from the peak of copulation to the peak of kidding. In 1967-1968 this was December 1 to May 31, a total of 183 days.

#### 5.1.4 Appearance of the Pregnant Female

It is extremely difficult to differentiate between pregnant and non pregnant females. Angular form and heavy winter pelage effectively camouflage any visible indications of pregnancy such as Egerton (1962) described for the bison.

#### 5.1.5 Behavior of Pregnant Females

Preparturient females leave the population and retire to secluded areas 1 or 2 days prior to parturition. If a female was accompanied by a yearling she tried to drive it off with short rush threats and frequent horn threats. Yearlings appear reluctant to leave their dams, remaining within 100 yards of her even after the birth of the new kid. Rejected yearlings often leave the vicinity of their mothers



and join transient groups of young animals.

With approaching parturition the female's periods of feeding, bedding and rumination become irregular and interspersed with periods of prolonged inactivity. Immediately prior to parturition the female's movements are restricted to a small area.

#### 5.1.6 Parturition and Post Partum Behavior of Dam and Neonate

I never observed birth of a kid. On several occasions females and neonates were discovered immediately after birth, when both dam and kid were still dishevelled. On three occasions particular females were closely watched since I felt that they were near term. Visual contact was lost with these females for 20-30 minutes and in this interval their kids were born. When rediscovered all dams were standing but whether they had given birth in this position was uncertain. On five occasions new kids were discovered that were incapable of standing. I believe that on several occasions I found kids which were less than 30 minutes old; these kids while able to stand were extremely unstable upon their feet.

Dams cleanse their neonates soon after delivery, licking them vigorously beginning at the head and working backwards over the rest of its body. Cleansing of neonates was nearly complete when I discovered most of them. During the first hour of life kids are licked almost continually and before cleansing is complete they are struggling to stand.



I was unable to determine how fetal membranes and birth fluids are disposed of. Several birth places were visited within 24 hours of delivery and no evidence of the birth process was found. It is possible that fetal membranes are eaten by the female or any of several scavengers such as coyotes (*Canis latrans*), wolverines (*Gulo luscus*) and golden eagles (*Aquila chrysaetos*), all of which frequent Mount Wardle.

Following cleansing, kids are usually nursed and bedded. Dams remain close to their kids for the first day, feeding nearby and frequently returning to examine them and perhaps to lick their faces and anal regions. Newly delivered females spend much time bedded in bodily contact with their young, until they leave isolation. Kids bed tight against their dams on her uphill side (Fig. 62).

#### 5.1.7 Early Neonate Behavior

While being cleansed by their dams, neonates attempt to stand. These attempts result in repeated tumbles. On getting to their feet kids stand and move about unsteadily. Locomotive ability of new kids improves rapidly and within a short time they are capable of following their mothers. New kids spend most of their first 2-3 days following birth, bedded within 50 feet of their birth place.

Early in life kids begin playing; climbing about on their bedded dam, butting her hind legs and licking her face and neck. Kids were frequently observed rubbing their backs against the face and chin of bedded females and leaning




Fig. 62 New born mountain goat kid bedded on the uphill side of its mother.





against their faces.

#### 5.1.8 Nursing Behavior of Dam and Neonate

A neonate nurses soon after gaining its feet. Initial nursings are awkward, uncertain and accompanied by frequent falls. I have observed kids examining their mothers from the front end and from between the forelegs suggesting that in initial nursings kids have difficulty in finding and manipulating the udder. Nursing kids butt the udder vigorously and twitch their tails continuously.

When nursing a female positions herself before the kid, seemingly to present a broadside outline to it. When a kid begins to search the angle between the hind leg and ventral line the dam shifts her hind leg slightly on the side from which the kid is investigating. Neonates normally stand at an angle of approximately 45 degrees to the female who stands with hind legs slightly spread (Fig. 63). The kids tail is pointed at the female's shoulder and its head is inserted between her hind legs but rarely do kids stand full length beneath the body of the female. Kids nurse from either right or left side showing no obvious preference and may in a single bout suckle right and left teats from either the right or left side. Nursing from behind between the hind legs of the dam is seldom attempted and was never successful in my observation. The udder of the female is small and positioned well back with the teats pointed forwards. Positioning of the teats makes nursing from behind extremely difficult.

Fig. 63 Nursing positions of the female and kid mountain goat.





When nursing, females examine their kids frequently, sniffing and licking their perianal region (Fig. 63). Kids improve their nursing techniques rapidly and within 24 hours go directly to the udder to suckle.

Early nursing bouts were frequently ended by the kid. Later after the first 2-3 days it is always the female that ends nursing bouts by moving away from the kid. If the kid persists in attempting to nurse the dam pushes it aside with the side of her head or horn threatens it.

Newly delivered females may be identified while feeding by the slow careful way in which they move their hind legs. New kids frequently move back and forth beneath their mothers and are occasionally stepped upon. Careful movement by the female undoubtedly prevents injury to kids through trampling.

Restriction of frequency and duration of nursing is at the discretion of the female. Kids soon assume an active role in seeking nourishment through nursing. They frequently prod their bedded mothers and run and climb about on them. Kids often attempt to shove their noses under the flank of their bedded mothers while trying to reach their udders.

Nursing is initially the only source of nourishment available to new kids. Within one week kids begin mouthing and nibbling plants taken by their mothers. After about a month nursing is probably of small importance in the diet of the kid, since at this time it is feeding at the side of its mother and nursing for short infrequent periods.



#### 5.1.9 Nursing Initiation

Nursing bouts are initiated under several recognizable conditions. They occur frequently when a female gets to her feet, stops feeding or when she returns to her bedded kid. Nursing bouts may be induced by disturbances of any kind such as separation from the dam, aggressive behavior of another goat, or danger from a predator. In times of stress a kid's reaction is to rush to its dam and suckle.

When females and kids become separated the dams become agitated and begin searching for their kids. When locating each other the female immediately allows the kid to nurse. Following such a nursing bout a kid crowds against its dam where it may remain for some time. Disturbance nursing decreases with time although I observed it in October when nursing was extremely rare.

#### 5.1.10 Duration and Frequency of Nursing

Data were collected on the frequency and duration of over 350 nursing bouts, successful and unsuccessful (Figs. 64, 65, and 66). A single nursing bout is defined here as the period from the moment the kid attempts to suckle until either the female moves away or the kid voluntarily ceases suckling. Nursing bouts were timed from the initiation of actual nursing until the kid voluntarily ceased or the female moved off.

Nursing bouts soon after birth are frequent, occur at irregular intervals and are of extended duration. Nursing bouts were recorded as long as 17 minutes and as frequently

Fig. 64 Mean length of nursing bouts for 1967 and 1968. Time beginning from the last week of May.

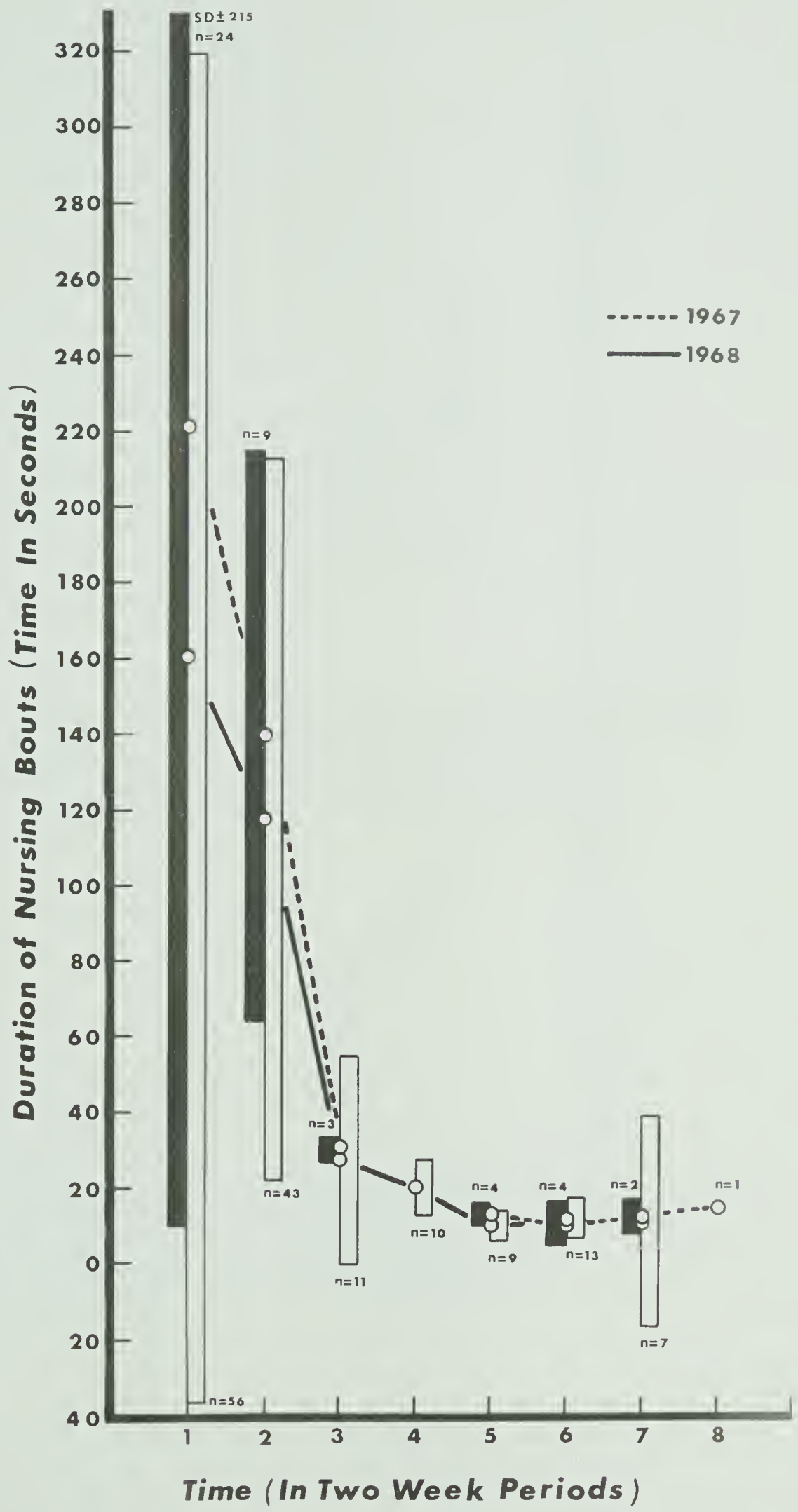
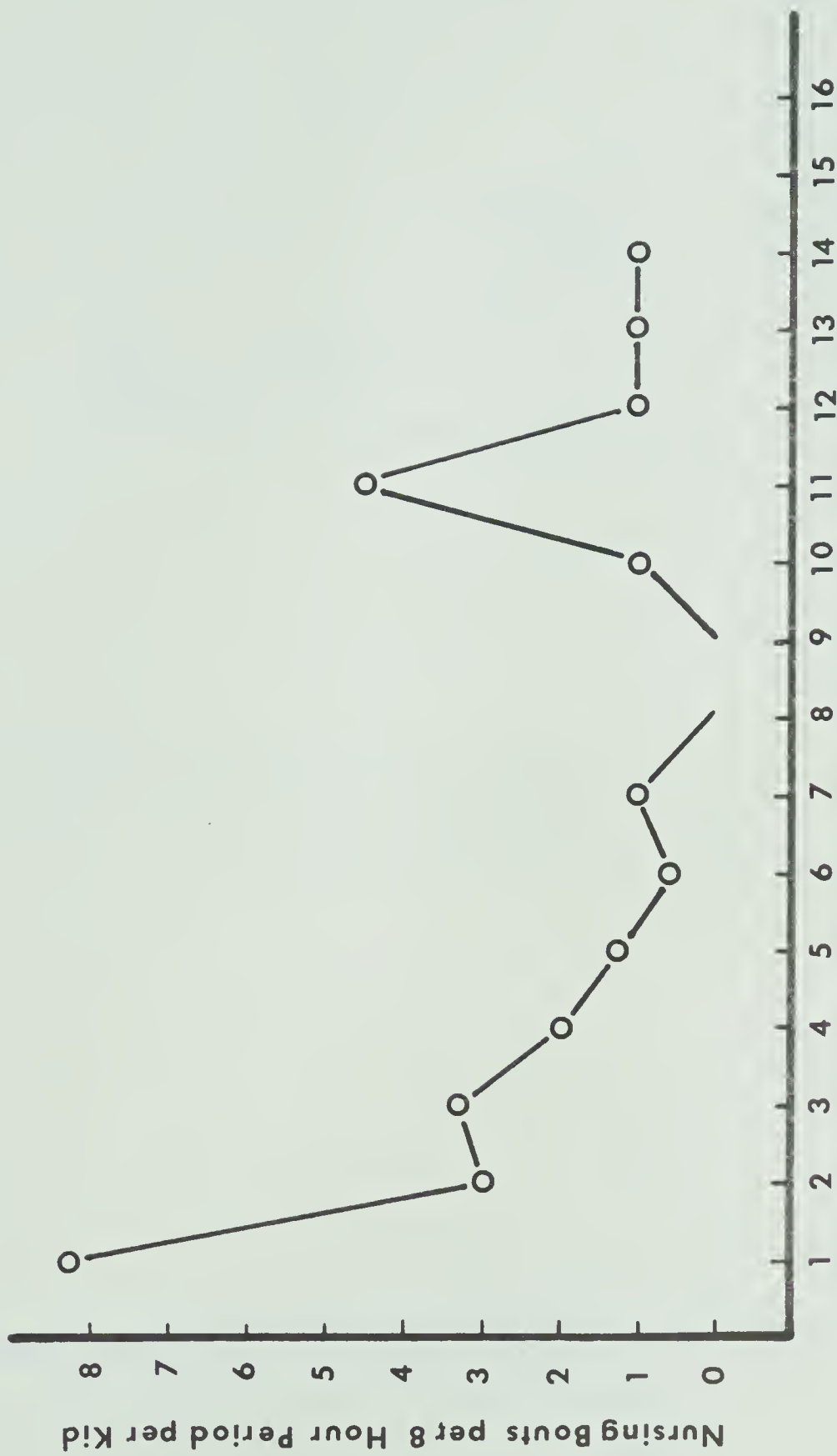
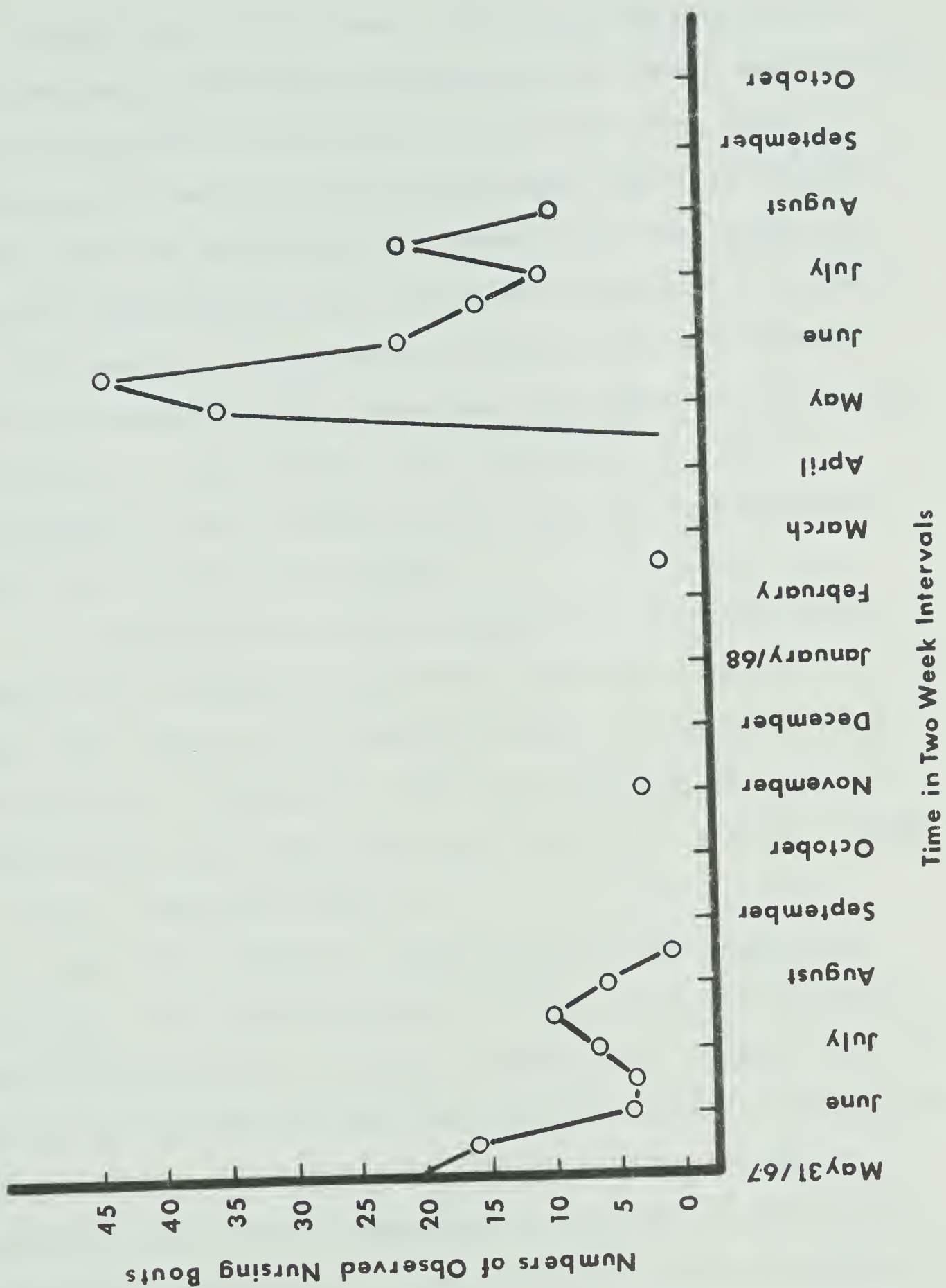


Fig. 65 Frequency of nursing bouts in kids per  
8 hour periods. Time 0 = May 24, 1968.



Time in Weeks 1968

Fig. 66 Over all observed frequency of nursing bouts for 1967 and 1968.





as 12 times in a single hour. Within a few days of birth kids become proficient at nursing and frequency and duration of nursing declines to three or four bouts per day. Frequency and duration of nursing bouts decrease rapidly until kids are approximately 5 weeks old, when they are nursing approximately once per 8 hour observation period for 30 seconds. At the age of 4 weeks kids are feeding extensively beside their dams and milk appears to have only a behavioral significance and to be merely a dietary supplement. After 6 weeks, mean length of nursing bouts stabilizes at about 15 seconds.

In August most nursing attempts are resisted by the female which refuses to stand for her kid or pushes it aside. Goat kids appear to be weaned by their fourth month (Figs. 64 and 65). In September 1967 one attempted nursing was observed and four were observed in the same period in 1968.

#### 5.1.11 Maternal Behavior

Goat kids remain in isolation with their dams for 3-5 days. The female maintains their isolation by driving off all other goats. Several observations suggest that the period of formation of possible filial bonds or recognition of the dam is relatively extended for the kid. While in isolation the kid will approach and attempt to follow any goat which approaches it. In a typical series of observations on May 30, 1968 two adult goats and a yearling approached a female and her 30 hour old kid. The dam became extremely agitated, stamping her forefoot and tossing her head. The



dam then moved between her kid and the strange goats and repeatedly horn and rush threatened them. The kid moved around its dam and approached the intruding goats with no fear. When the female drove the strange goats off the kid tried to follow them. On several occasions kids were observed trying to approach and follow yearlings. I do not feel that kids are capable of recognizing their mothers for some time, at least until they are taken out of isolation.

While the critical period, or period of acceptance, for the kid may be of extended length there is evidence for a short critical period for the dam. On May 21, 1967 I discovered a kid which could barely stand. The dam repeatedly rushed at her nearby yearling and a 2-year-old. The dam then turned and rushed at a nearby displaying male blue grouse (*Dendragapus obscurus*) which was within 30 feet of the kid. The above observation and the preceding observation of the dam and her 30 year old kid suggested an early formation of a maternal bond. On May 22, 1967 while attempting to photograph a kid known to be 18 hours old I had the kid approach to within 15 feet, I believe the kid would have continued to approach had I not been driven off by its dam. The female then led the kid away over some very rough terrain. The female frequently had to stop and return to her kid as it had difficulty following her over some of the terrain, but she would not abandon it even when pressed closely by the observer.



The first stage in the kids social integration is its introduction into small groups of two or three females and their young. Occasionally yearlings of one or more of the females return and remain on the periphery of the group. Kids begin to range farther from their mother, they begin encountering other kids and first attempts at associative play begin.

After joining other females and their young the dams and kids remain on the eastern half of the mountain. These groups appear to be nursery bands. The area in which the female-young groups aggregate may be tentatively termed nursery areas. Nursery groups integrate with the rest of the population approximately 10 days after birth of the new kids. At that time kids are participating in associative play and are visiting mineral licks with their mothers.

Communication between mother and young appears to be vocal and visual. When a female begins to move she stops and looks directly at her kid and then moves off. If the kid is slow to follow, the female again stops and looks at it until it follows. Mother-young recognition appears to be basically olfactory. On numerous occasions when mother and young had become separated both began vocalizing and searching for each other. Initially when kids begin vocalizing all goats in a group will respond and look for the source of the crying. Kids searching for their mother keep giving a high-pitched, piercing bleat that is clearly audible at 500-600 yards. Crying continually,



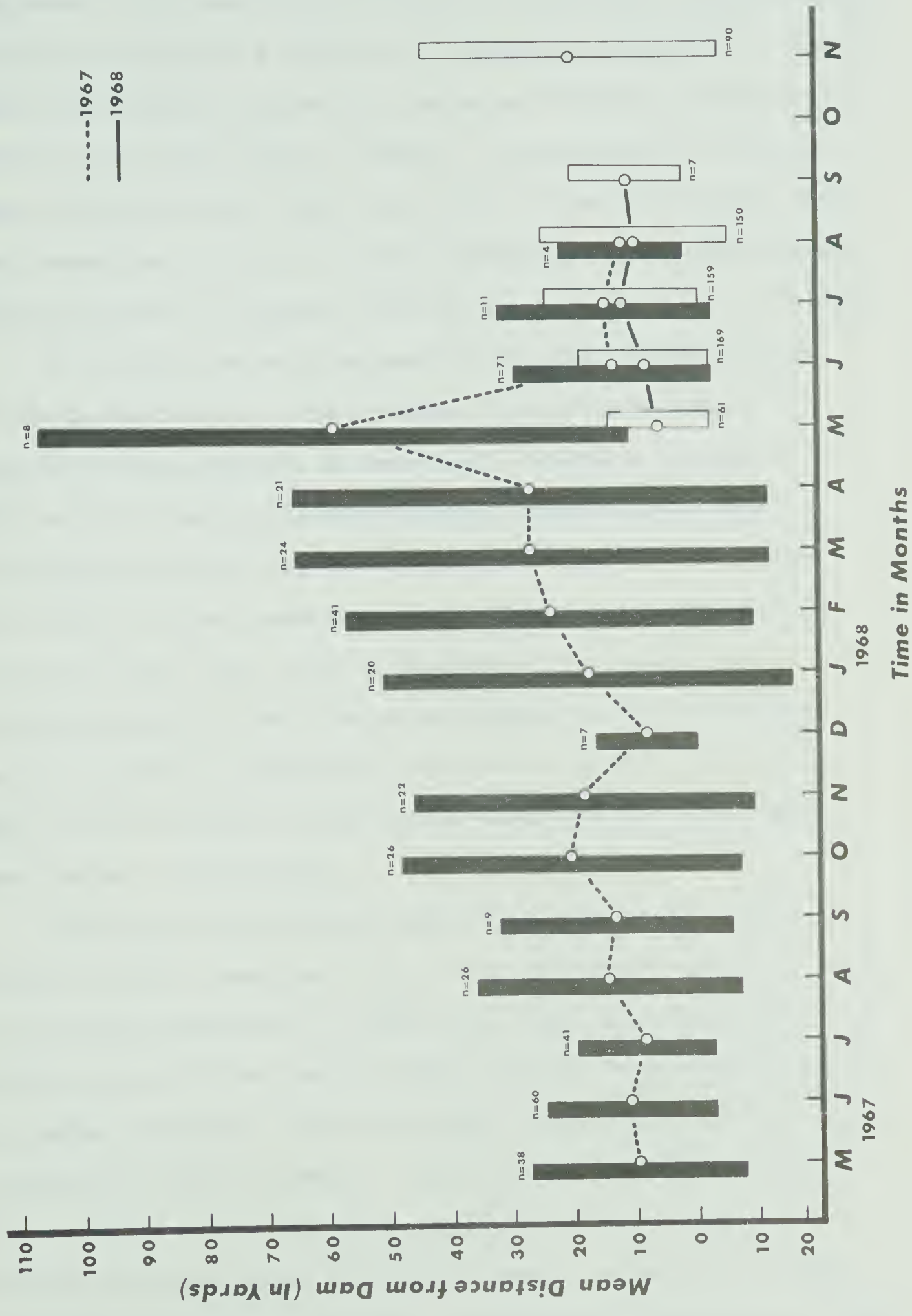
kids approach various adult females in the group and examine them olfactorily. Normally a lost kid does not leave voluntarily but is driven off by intolerant group members. The kid continues to wander aimlessly until its dam is located. On locating its dam a kid rushes to her and they touche noses after which the dam smells it carefully then nurses it.

#### 5.1.12 Dynamics of the Maternal Bond

Early in this study it became apparent that the influence exerted on a kid by its dam was not constant. It was my impression that with time kids became more independent of their mothers. A method of representing the trends in strength of the maternal-filial bond was desirable. I attempted to measure the frequency with which kids move into each of the various distance classes, when moving away from their mothers. With this system I found a distinct expansion of distance between mother and young with time (Fig. 67). The frequency of movement into various distance classes may be considered as a measure of independence of the kid.

The pattern of maternal-filial bond relaxation was constant for 1967 and 1968. Expansion of distance continues from birth until the breeding season. A much larger sample size in 1968 gives a more refined picture of the early bond dynamics. Kids leave the proximity of their dams, expanding the circle of their activity gradually until July, when the rate of expansion stabilizes until

Fig. 67 Mean mother-young distance for kids and yearlings  
for 1967 and 1968.





September. At the onset of the rutting season mother-young distance undergoes a marked but temporary expansion. There was no evidence of agonistic behavior directed towards the kid by either the male or female. Occasionally kids are horn threatened but they are rarely driven off except from the immediate vicinity of their mothers. Increased mother-young distance is obvious during the rutting season of 1968.

Following the rutting season the mean mother-young distance decreases. The December contraction shown in Figure 67 was probably a result of inclement weather. High winds, deep snow and freezing temperatures were concurrent with bodily contact between mother and young, particularly when bedding. As a result of the deep soft snows in the latter half of December most goats were concentrated in a small area of broken cliffs and bluffs on the southeast portion of the winter area. This area was out of the wind and afforded some shelter under trees and against cliff faces.

When snow and weather conditions improved, mother-young distance expanded again at a relatively constant rate. I observed kids born in 1967 until they were 16 months old. At the onset of the next kidding season, mean mother-young distance increased. When new kids arrived, yearlings were rejected by their mothers. Driving the yearling off at the birth of a new kid does not seem to be a final severance of the maternal-filial bond. Severance of the maternal-filial bond appears to be at the discretion of the female.



If after the kidding season the female is not involved with the care of a new kid, she will occasionally allow her yearling to rejoin her and the mother-yearling distance contracts. There appears to be a resurgence of the maternal-filial bond. Yearlings whose mothers failed to bear, begin body contact with their dams and remain in close proximity when moving. Yearlings whose mothers had a new kid are forced to remain some distance from them. On three occasions during the 1968 kidding season yearlings were observed attempting to nurse; all of these females did not have new kids. It was impossible to determine whether all nursing attempts were made by the same yearling.

#### 5.1.13 Caching Behavior

Caching is an interesting aspect of maternal behavior in the mountain goat. When caching their kids females leave them in a concealed position in a secluded area while they move off to feed. The kids remain concealed until their mother returns. In two kidding seasons for which I have data caching behavior was observed only six times.

Caching behavior did not appear to be a result of any threat to mother or young. The dam simply led her young to a protected spot often on a ledge shaded with shrubs, then moved off to feed. Twice females were observed to feed as far as 200 yards from their kids. A female with twin kids was observed to cache both kids twice in a day. The kids became impatient, left their concealment and began searching



for their dam. The dam returned, retrieved her wandering kids, nursed them, took them back and cached them again in the same place.

#### 5.1.14 Protection of Kids

Protection of kids from agonistic actions of other goats and the threat of predators is an important aspect of maternal behavior. A wide range of predators capable of taking a goat kid live on the study area. I saw few overt attempts at predation. A pair of golden eagles which reside on Mount Wardle frequently harassed goats of all ages. I observed four attacks by eagles on young goats, three on kids and the other on two yearlings. No attack was successful.

In two attacks on kids the mothers spotted the eagle stooping on their kids and ran towards them. The kids ran to their mothers and rushed beneath them. Once a female and kid fled into a stand of whitebark pine and remained under low hanging bows until the eagle had left. None of the three attacks were pressed with any vigor, the eagles making single passes only.

Two eagle attacks took place in cliff areas. The eagles attempted to knock the kids off ledges. Attacks on larger goats are carried out in the same manner, the eagles attempt to knock or chase them off ledges or cliffs.

Females protect their kids from eagles by either sheltering them with their bodies or leading them under trees or overhanging ledges. Lone goats harassed by eagles



watched the bird carefully. When caught in the open an adult goat either squatted as described by Brandborg (1955) or fled. Goats being harassed by eagles went beneath trees whenever possible. On two occasions coyotes were observed in position to attack goat kids.

On July 31, 1967 I observed two golden eagles attempting to approach a dead kid. The kid had been killed by another goat or had speared itself while playing. The mother of the dead kid repeatedly rushed at the eagles when they approached within 25 yards of the carcass. The female held the eagles off for 1 hour 20 minutes before I approached the kid to measure and examine it. The female rushed at me and had to be driven off with thrown rocks and even then she remained within 50 yards of the dead kid. The female remained with the body of her kid protecting it for 2.5 days before finally abandoning it. In two other cases, kids which were diseased with contagious ecthyma\* were captured and killed by myself and park wardens with no interference from the females.

A final aspect of maternal behavior is protection of kids from aggressive behavior of other goats. Dams protect kids by driving off all other goats with the exception of other kids.

## 5.2 Discussion

### 5.2.1 Kidding Season

The goat kidding season in the Vermilion Range is

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\*Diagnosis done by Province of Alberta Department of Agriculture Veterinary Laboratory, Lethbridge, Alberta.



remarkably short, approximately 2 weeks from late May to mid-June. The recorded range is from February 27 (Brandborg 1955) to June 29 (Kerr 1965).

Diurnal distribution of births of new kids, as presented in Table 15, suggest that the majority of births occur in the afternoon. Births of domestic sheep and goats are distributed randomly throughout the day (Hersher, Richmons and Moore 1963).

#### 5.2.2 Behavior of Pregnant Females

Several behavioral features found in female goats are also known in other species. Isolation and proximity of escape terrain are sought by pregnant mountain sheep (Davis 1938, Spencer 1943, McCann 1956). Escape terrain forms a necessary prerequisite for a successful sheep range (Blood 1963).

#### 5.2.3 Gestation Period

Such basic information as the length of the mountain goat's gestation period is debated. Estimates of length range from 147 days (Kenneth 1943 in Asdell 1964) to 191 days (Holroyd 1967). I estimate the gestation period to be 183 days.

#### 5.2.4 Behavior of the Post Partum Female and Neonate

Parturition was not observed but data indicate that the total act of parturition can occur within 20-30 minutes. I suggest that rapid birth would confer a selective advantage among wild ungulates. Rapid delivery would decrease the time mother and young would be immobile and thus subject to attack by predators. It is not certain what position is assumed by the parturient female during



the delivery although all were standing when discovered shortly after delivery. Hersher *et al.* (1963) described parturition as occurring in both standing and bedded positions in domestic sheep and goats. They also observed that the delivery of the neonate of domestic sheep and goats was head down and forefeet first.

Seton (1927) in describing the birth of a mountain goat kid in captivity reported that it was on its feet in 10 minutes and playing in 30 minutes. Assuming Seton's (1927) observations to be normal for new goat kids; for my observations I believe that on several occasions I discovered kids less than 30 minutes old.

New kids are cleansed soon after birth; this type of maternal behavior is widespread among ungulates. Hersher *et al.* (1963) found that ewe sheep and goats began licking neonates almost immediately after delivery.

I was unable to determine how birth fluids and fetal membranes were disposed of, whether they were consumed by the female or by any of several carrion eaters. In mountain goats I feel that consumption of birth membranes would be of survival value for the species because mother and young remain in a restricted area for some time (3-5 days). Afterbirth would serve as an attractant for carrion eaters (e.g., coyotes and wolverines), which could endanger mother and young.

#### 5.2.5 Nursing Behavior

Goat kids start nursing soon after birth. Goat kids



born in captivity nursed within 20 minutes of birth (Seton 1927). Initial nursing attempts lack direction and coordination. I have observed kids when first standing make sucking motions which seemed directed towards the nearest body protruberance of their dam. Other authors have found that young ungulates may direct sucking motions toward any body protruberance (Hafez and Schein 1962). The young of ungulates seem to be born with the urge to suck. Several ungulate neonates are said to make sucking motions toward their dams before ever having nursed (Hafez and Schein 1962, Hersher *et al.* 1963).

Mountain goat kids are apparently attracted to the angle formed by the dam's legs and ventral line. Various workers have demonstrated in domestic sheep and cattle, that udder seeking behavior is at first directed towards the angle of the leg and ventral line of the mother (Hafez and Schein 1962). Evidently ungulates are not born with an innate knowledge of the location of the udder but must search for it. Egerton (1962) suggested that the attraction for angles formed by the body and leg may be innate. This apparent attraction for angles in neonates has been reported in most ungulates in which nursing behavior has been studied. Once the udder is located the young go directly to it. I agree with Egerton (1962) that young must learn the udder's location but I suggest that its location is learned very rapidly.

Kids normally assumed a lateral position when nursing



but on occasion kids attempted unsuccessfully to suckle from directly behind, between the hind legs of the dam. When kids tried to nurse from behind, females disrupted the attempt by simply moving forward.

Tail wiggling and udder butting are normal parts of nursing behavior in goat kids. The duration of early nursing bouts is often determined by the kid. Some early bouts of unusual length (17 minutes) are probably due to the inexperience of the kid. Brandborg (1955) has previously commented upon the unusual length of some early nursing bouts in goat kids. Duration of later nursing bouts is determined by the mother who ends them simply by moving away from the kid. Nursing kids are often knocked down when the female walks away from them.

Conditions and situations which appear to give rise to nursing bouts are varied. Lactating females rarely check to see if their kids are following them when they are travelling. Since kids often get involved in licking or playing, separations are frequent. Such separations normally end with a brief period of nursing. Brandborg (1955) has reported nursing which followed separation and situations which were dangerous to the kid. Nursing seems to serve as an inducement to keep the young close to the mother thus reducing the possibility of separation.

Nursing frequency decreases rapidly from birth and by September nursing bouts are rare. I suggest that kids are weaned by the end of their fourth month. Brandborg (1955)



found that females taken by hunters in September 1950-53 were still producing milk but in small quantities.

#### 5.2.6 Establishment and Maintenance of the Maternal-Filial Bond

In species with extended periods of parental care the establishment and maintenance of maternal-filial bonds should be of critical importance in survival of the young. Hersher *et al.* (1963) hypothesized that there are two prerequisite conditions contributing to establishment of a maternal-filial bond: cleansing the young of fetal membranes and a "critical period" for bond formation following birth. Hersher *et al.* (1963) suggest that a "special sensitivity or lack of sensitivity", to her own scent may attract the dam to the kid carrying that odour. If this sensitivity does exist it would obviously facilitate bond formation between mother and young.

Observations suggest that the period of isolation, which is forcefully maintained by the female goat, may be the critical period suggested by Hersher *et al.* (1963). Kids seem unable to recognize their dams for some time following birth, although dams quickly accept and protect their kids. Brandborg (1955) cited an incident wherein a kid was unable to leave the ledge upon which it was born. Its dam repeatedly returned to nurse it and ultimately led it to freedom. From observations on new kids it is my impression that the critical period for formation of a filial bond takes place over the 3-5 days of isolation.



The critical period for maternal bond formation appears to be very short, possibly in the order of 1-2 hours. It has been determined that domestic sheep and goats have a critical period of approximately 1-2 hours after which they will not accept their young (Hersher *et al.* 1963).

#### 5.2.7 Communication and Recognition of Mother and Young

Communication and recognition between dam and kid are important factors in maintaining a maternal-filial bond. Anderson (1940) noted in goats that vocal communication was often used when kids became separated from their dams. Communication by direct looks is important in following behavior between female and kid.

#### 5.2.8 Caching and Protective Behavior

Kids generally remain in close proximity to the female. Caching of young while, occurring in ungulates such as wapiti (Altman 1963) and deer (Dasmann and Taber 1956) is rare in the mountain goat. Hanson (1950) considered caching to be normal behavior for female mountain goats in North Dakota but this was not found to be the case by me in this study. Caching behavior seems poorly developed in the mountain goat. This is suggested by the low numbers of observations and the behavior of kids which were cached. In species with well developed caching behavior such as the wapiti (Altman 1963) and deer (Dasman and Taber 1956) the young remain totally immobile until the mother returns. The above species cache their young for extended periods. All those occasions which I observed in the mountain goat



were of short duration, on the order of 2 hours. Caching of kids in mountain goats seems to be a matter of convenience, allowing the female greater freedom than if she were followed by a slow moving kid.

Protection of kids from injury and predators is an important aspect of maternal behavior. Females protect young kids from injury through falls by maintaining a position directly below them whether moving or bedded. Holroyd (1967) commented on the fact that goats kept their young above them on the slope whether they were moving about or bedded, and Geist (1966) observed the same behavior in mountain sheep.

The main predator of new kids appears to be the rarely successful golden eagle. No successful eagle attacks were observed during the course of study. Brandborg (1955) and Anderson (1940) both cited attacks by eagles on mountain goats. The eagles attempted to knock goats off ledges. In two cases kids were plucked off ledges or cliffs; the eagle managed to glide while grasping the kid but was unable to fly actively. Predation as a whole appears to be slight on new kids.

#### 5.2.9 Dynamics of the Maternal Bond

The bond between female and kid does not remain stable over the year but undergoes a deterioration; the mother-young distance expands and contracts depending upon circumstances. During the rutting season there is a marked increase in the mother-young distance. Increased mother-



young distance may reflect a lapse in the maternal bond while the female is involved in rutting activity. During the kidding season mother-yearling distance increases markedly.

Data suggest that if a female fails to bear a young every year she may allow her yearling to remain with her for at least 16 months and possibly as long as 18 months. This behavior has been reported for a few species and perhaps with more observation it will be found to be more widespread than is presently recognized.



## SECTION SUMMARIES

1. Comfort and Maintenance Behavior

Comfort and maintenance behavior in the mountain goat may be subdivided into those acts which are constant and those which are seasonal in occurrence. Eliminative behavior with sexual dimorphism in urination posture is, of course, constant. Preferential bedding and dirt-bathing areas are maintained. Stretching and yawning are constant comfort acts which are not linked to sex or age. Scratching is the commonest comfort act. Certain types of scratching behavior are seasonal. Scratching is performed in a variety of ways, many of which are associated with bedding behavior. Seasonal scratching appears to be stimulated by irritation caused by ticks, biting insects and molting winter pelage. Body shaking is a constant comfort act directed towards the removal of foreign substances from the body surface and the rearrangement of the pelage. Bedding is a basic constant comfort act around which several other types of comfort behavior revolve. Dirt-bathing, a common type of comfort behavior in the mountain goat, appears to be connected with the bedding act. It is extremely seasonal and consists of a variable pattern incorporating many other comfort acts, particularly scratching. Certain situations such as proximity to preferred sites, stress situations, high ambient temperatures and irritation appears to stimulate dirt-bathing. Comfort and



maintenance behavior in the mountain goat, as in other species, appears to be an attempt to maintain a constant, equable condition for the individual animal.

## 2. Social Structure and Behavior

The mountain goat population wintering on Mount Wardle consists of two loosely organized subpopulations: adult male and female-young groups. The subdivisions remain more-or-less distinct except during the rutting season. The groups use different parts of the wintering area. Mean size and composition of groups fluctuate throughout the year.

Mountain goats possess a repertoire of several threats and several types of submissive behavior. Submissive behavior centers on fleeing or expressing a desire not to fight by suppressing weapons presentations and emphasizing total vulnerability to attack.

Males precede female-young groups to summering areas and follow them back to the wintering area later. Mineral licks are used at different times by female-young groups and males.

Social ranking of adult males and females seems to be about equal. The social structure of female-young groups is a linear dominance, adults dominating 2-year-olds, which dominate yearlings, which in turn dominate kids. Males tend to ignore kids and juveniles, and are mildly intolerant of young males. There are few aggressive interactions within male groups, whereas female-young groups



have a high incidence of aggressive behavior.

### 3. Play in the Mountain Goat

Mountain goats begin to play within 8 hours of birth and continue playing into adulthood. Play frequency increases rapidly throughout the first months, then falls to a low frequency for the remaining life of the goat. There are two basic play forms, solitary and associative. Solitary play encompasses all play acts performed by a lone kid: leaping, spinning, butting its mother, and bucking. Associative play begins when the kid leaves isolation and joins female-young groups with its mother. This play form involves more than one goat and generally has an enriched repertoire of mutual butting, mounting, neck fighting as well as all the play acts of solitary play. Play may occur by invitation or by spontaneous interaction of two kids.

Play in adult goats is rare and when it occurs it involves much the same play patterns as in the solitary kid. Play involving different ages of goats is rare but of the solitary play form. Many acts in the play repertoire of the kids have counterparts in the serious behavior of later life. I suggest that play has survival value in providing experience and knowledge of the environment to the new kid. Play in new kids also increases strength and coordination as well as muscular tone. Play may be of value in severing the maternal-filial bond and easing the social integration of the young goat.



#### 4. Reproductive Behavior in the Mountain Goat

The rutting of the mountain goat begins in early November and lasts for approximately 1 month. Early courtships are hesitant but gain persistence and intensity late in November. Elements of male mountain goat reproductive behavior are similar to patterns widespread throughout the ungulate group.

Frequency of reproductive behavior increases from early to late November, then decreases abruptly. The peak of the rut falls in the latter half of November; at this time courtship bouts are most complex and copulation is most frequent. Frequency of courtship varies diurnally.

Mountain goats form tending pairs in which males remain with a single female for approximately 2.4 days, unless disturbed. During the tending period pairs move into isolated areas where copulation takes place. Copulation appears to occur only between members of tending pairs.

I found that 2-year-old males are sexually mature and are capable of tending and copulating with adult females, but males are generally not allowed to breed until their fourth winter as a result of interference by adult males. Males were not considered adult until at least 3-years of age.

Males performed two behavior patterns which were characteristic of the reproductive season: preparation of rutting pits and bush rubbing. These two acts were interpreted as probable marking patterns performed in conflict situations. Reproductive males are aggressive in



male-male interactions, resorting to the present threat and rush threat. Incidence of fighting was rare but disastrous when it did occur.

##### 5. Maternal Behavior in the Mountain Goat

Most mountain goat kids are born in a 2 week interval from the last week of May through the first week of June. Goat kids are born following a gestation period of approximately 183 days. The peak of the kidding season occurs on approximately May 31.

Parturient females seek isolated ledges, generally on the southeast face of Mount Wardle. Parturient females drive off their yearlings. Pregnant females cannot be detected among a herd of goats.

Birth of a kid takes place rapidly, probably taking only 20-30 minutes. The first act of newly delivered females is to cleanse kids of fetal membranes. Kids are precocial and are soon standing and attempting to nurse.

Females and kids remain in isolation for 3-5 days. Dams defend their kids from approach by all other goats. The critical period of maternal bond formation appears to be short, less than 24 hours, but formation of filial bonds may take 3-5 days. Kids do not seem to recognize their mothers for some time, although dams acknowledge their kids soon after birth. When first leaving isolation the female and kid join other family groups. Most kids are born on one region of Mount Wardle and remain there for at least a week following birth.



First nursing attempts are awkward. Kids have to search for the udder, but once it is found they soon become proficient at nursing. Initial nursings are frequent, irregular and of extended duration. Within a short time frequency and duration decrease to a low level, then decrease gradually until the kid is weaned. Weaning is complete at approximately 4 months.

Kids begin nibbling at vegetation at approximately 1 week old, and feed regularly at their mother's side when 4-6 weeks of age. Nursing is frequently used as an inducement for controlling kids. Nursing bouts frequently follow feeding, bedding periods or disturbances such as separation or imminent danger.

Females are extremely protective toward their young. Females were observed protecting their kids from eagles. Females also protect their young from aggressive actions of other goats.

The maternal bond is broken slowly and is finally severed by the female at the birth of a new kid. In some cases traces of the maternal-yearling bond may be observed when yearlings are allowed to accompany their mother and new kid. Kids remain in constant contact with their mother until arrival of the new kid when they are normally driven off.



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